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Soil Survey

Cheshire and Sullivan Counties New Hampshire

By

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UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Administration
Bureau of Plant Industry, Soils, and Agricultural Engineering
In cooperation with the
UNIVERSITY OF NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

SOIL SURVEYS provide a foundation for all land use programs. This report and the accompanying map present information both general and specific about the soils, the crops, and the agriculture of the area surveyed. The individual reader may be interested in the whole report or only in some particular part. Ordinarily he will be able to obtain the information he needs without reading the whole. Prepared for both general and detailed use, the report is designed to meet the needs of a wide variety of readers of three general groups: (1) Those interested in the counties as a whole; (2) those interested in specific parts of them; and (3) students and teachers of soil science and related agricultural subjects. Attempt has been made to meet the needs of all three groups by making the report comprehensive for purposes of reference.

Readers interested in the area as a whole include those concerned with general land use planning—the placement and development of highways, power lines, urban sites, industries, community cooperatives, resettlement projects, and areas for forest and wildlife management and for recreation. The following sections are intended for such users: (1) Counties Surveyed and Climate, in which location and extent, physiography, relief, and drainage, climate, water supply, vegetation, industries, organization and population, transportation and markets, and cultural development and improvement are discussed; (2) Agricultural History and Statistics, in which a brief history and the present status of the agriculture are described; (3) Productivity Ratings, in which productivity of the soil is discussed; and (4) Land Uses and Agricultural Methods, in which the uses and management requirements of the soils are discussed.

Readers interested chiefly in specific areas—as some particular locality, farm, or field—include farmers, agricultural technicians interested in planning operations in communities or on individual farms, and real estate agents, land appraisers, prospective purchasers and tenants, and farm agencies. These readers should (1) locate on the map the tract with which concerned; (2) identify the soils on the tract by locating in the legend on the margin of the map the symbols and colors that represent them; and (3) locate in the table of contents in the section on Soils and Crops the page where each soil type is described in detail and information given as to its suitability for use and its relations to crops and agriculture. They will also find useful specific information relating to the soils in the sections on Productivity Ratings and Land Uses and Agricultural Methods.

Students and teachers of soil science and allied subjects—including crop production, forestry, animal husbandry, economics, rural sociology, geography, and geology—will find their special interest in the section on Morphology and Genesis of Soils. They will also find useful information in the section on Soils and Crops in which are presented the general scheme of classification of the soils of the area and a detailed discussion of each type. For those not already familiar with the classification and mapping of soils, these subjects are discussed under Soil Survey Methods and Definitions. Teachers of other subjects will find the sections on Counties Surveyed, Climate, Agricultural History and Statistics, Productivity Ratings, and the first part of the section on Soils and Crops of particular value in determining the relation between their special subjects and the soils of the area.

This publication on the soil survey of Cheshire and Sullivan Counties, N. H., is a cooperative contribution from the—

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SOIL SURVEY OF CHESHIRE AND SULLIVAN COUNTIES, NEW HAMPSHIRE

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United States Department of Agriculture in cooperation with the University of New Hampshire Agricultural Experiment Station

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[1] The field work for this survey was done while the Division was a part of the Bureau of Chemistry and Soils.

CHESHIRE AND SULLIVAN COUNTIES lie within the New England Upland physiographic section. About 46 percent of the population lives in rural areas. The principal farm crops are corn, potatoes, and hay; the principal livestock, dairy cattle and chickens. Many farmers receive additional income from cutting wood and working in sawmills, and those along traveled highways profit from the tourist trade. Part-time employment for rural residents is furnished by textile, shoe, furniture, machine, and other factories in the industrial centers, and by the feldspar mines. To provide a basis for the best agricultural uses of the land a cooperative soil survey was begun in 1937 by the United States Department of Agriculture and the University of New Hampshire Agricultural Experiment Station. The essential features may be summarized as follows.

SUMMARY

Cheshire and Sullivan Counties occupy a plateau that slopes toward the south and west, surmounted by several sharp mountains, the most prominent of which is Monadnock Mountain. The plateau is deeply and rather thoroughly dissected by streams flowing into the Connecticut River. It is covered by glacial till, about two-thirds of which is derived principally from granitic rock debris and the rest from schist rocks. Soils developed on this till are naturally stony and not suitable for cultivation until the stones are picked off. The area covered by till derived from schist is less stony than that covered by till derived from granitic rocks, and soils developed on fine-textured (mostly schist) debris of the rolling and hilly uplands are inherently more fertile and less droughty than most of those derived from coarse-textured (mostly granitic) rock debris of the rolling and hilly uplands.

The Charlton soils are the most important soils developed from schist debris. Other soils developed from this kind of material are members of the Hollis, Woodbridge, Marlow, Blandford, Sutton, Essex, Peru, and Whitman series. In cultivated areas they have brown loam surface soils and yellowish-brown loam subsoils.

The Gloucester soils are the most important soils developed from granitic till. They have weak-brown sandy loam surface soils and yellowish-brown sandy loam subsoils in cultivated areas. A very small part of the Gloucester soils is cultivated. In forested areas a mat of partly decomposed organic matter overlies a 1- or 2-inch layer of mineral soil that is nearly white; the upper subsoil layer is brown or coffee-colored, and the lower subsoil layer is yellowish brown. Other soils developed from similar coarse-textured material are members of the Hermon, Canaan, Shapleigh, and Brookfield series. The Hinckley, Danby, and Jaffrey soils are formed over gravelly and sandy kame deposits, and the Windsor soils are formed over windblown sand deposits.

In the valleys of the Connecticut River and the tributary streams the soils have developed from material deposited by water. Part of them are terraces or glacial outwash plains, and part are level stream bottoms. Firm or compact fine-textured substrata underlie the Suffield, Hartland, and Melrose soils; medium-textured substrata underlie the Agawam soils; and coarse-textured sandy or gravelly strata underlie the Merrimac, Adams, Colton, and Sudbury soils.

The Hadley and Ondawa soils, the Podunk-Rumney soil complexes, and the Alluvial soils, undifferentiated, comprise the soils of the bottom lands, or the alluvial flood plains of all streams. The Agawam and Hadley soils are very important agriculturally, even though they are not extensive, as they are the most productive soils in the area.

A large number of soil types and phases and land types are shown on the accompanying map, including 69 mineral soils, 4 organic soils, and 10 miscellaneous land types. The individual soil types and phases belong to 30 soil series.

COUNTIES SURVEYED

Cheshire and Sullivan Counties occupy the southwestern part of New Hampshire (fig. 1). Sullivan County is north of Cheshire

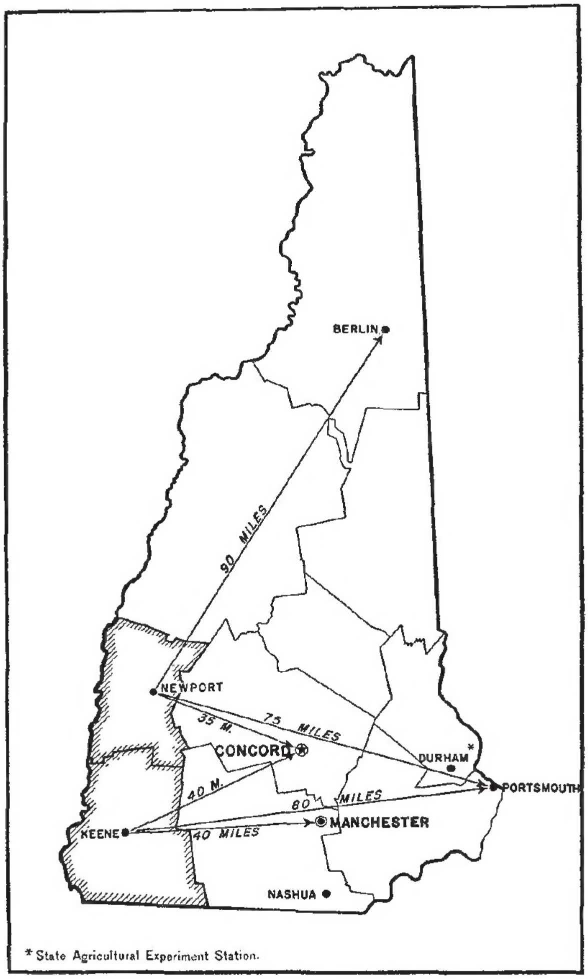

FIGURE 1.—Location of Cheshire and Sullivan Counties in New Hampshire.

County, and the west bank of the Connecticut River forms the western boundary of both. The northern end of Sullivan County is about 65 miles north from the New Hampshire-Massachusetts State line. The two counties have an average width of about 20 miles, but Cheshire County in some places is 30 miles wide. Keene, the county seat of Cheshire County, is about 90 miles from Boston, 40 miles from Manchester, 100 miles from Albany, and 215 miles from New York City. Newport, the county seat of Sullivan County, is about 110 miles by highway from Boston, 75 miles (by air line) from Portsmouth, 135 miles from Albany, and 250 miles from New York City. Both counties are roughly rectangular. The area of Cheshire County is 708 square miles, or 453,120 acres, and that of Sullivan County is 537 square miles, or 343,680 acres.

The area covered by this survey lies within the New England Upland physiographic section.[2] In general, it is a dissected plateau that slopes to the south and slightly to the west and is dotted with monadnocks. The most prominent of these monadnocks are Croydon Mountain (elevation 2,781 feet above sea level[3]) in the north-central part of Sullivan County and Monadnock Mountain (elevation 3,165 feet) in the southeastern part of Cheshire County. A well-defined ridge that reaches an elevation of more than 2,000 feet in many places extends northward from Monadnock Mountain to Sunapee Lake. A broad, low ridge or plateau, slightly higher than the main plateau, parallels the Connecticut River in the western parts of the counties. The average elevation of the main plateau ranges from about 1,000 feet in the southwestern part of Cheshire County to 1,600 feet in the northeastern part of Sullivan County. It is thoroughly and deeply dissected, especially in the western part. The larger brooks and creeks flow swiftly through narrow, steep-sided valleys. The stream pattern is dendritic, except adjacent to the Connecticut River, where it is trellised.

In the vicinity of Keene there is an almost flat valley nearly 3 miles wide, which is said to mark the location of a former glacial lake. In many places the local relief is pronounced, and almost precipitous slopes with local differences in elevation of as much as 500 feet are common, especially in the western part of Cheshire County. Near the headwaters of the streams most of the slopes are gentle, less than 200 feet to the mile. All the area, except a narrow strip along the eastern side of Cheshire County that drains through the Contoocook River into the Merrimack River, lies within the drainage basin of the Connecticut River. The valley of the Connecticut River in southern New Hampshire is narrow, in most places less than half a mile and in very few places more than 1 mile wide, and is bordered by very steep to precipitous sides that are cut in only a few places by streams draining the plateau. In general, these smaller streams have less precipitous valley walls than the Connecticut River.

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[2] FENNEMAN, NEVIN M., in cooperation with the Physiographic Committee of the United States Geological Survey. PHYSICAL DIVISIONS OF THE UNITED STATES. U. S. Geol. Survey map. 1930.

[3] Elevations given in this section are taken from U. S. Geological Survey topographic sheets.

They follow the slope of the plateau in most places, but the Sugar River flows almost directly west. The most important of these tributary streams are the Sugar River in Sullivan County and the Ashuelot River in Cheshire County. The Sugar River rises in Sunapee Lake at an elevation of 1,091 feet and, after flowing about 25 miles, enters the Connecticut River at an elevation of 300 feet. The Ashuelot River leaves Ashuelot Pond in Sullivan County at an elevation of 1,445 feet, falls to an elevation of 460 feet at Keene over a distance of about 25 miles, and enters the Connecticut River at an elevation of 200 feet. The Connecticut River enters the area at an elevation of 320 feet and falls about 20 feet in traversing about 40 miles along Sullivan County. A short distance from the point where it enters Cheshire County it falls nearly 60 feet in the vicinity of North Walpole (Bellows Falls, Vt.) and leaves Cheshire County at an elevation of 180 feet.

The original vegetation, still to be seen on Mount Pisgah (*7*)[4] northwest of Ashuelot, consisted of eastern hemlock (*Tsuga canadensis* (L.) Carr.), eastern white pine (*Pinus strobus* L.), yellow birch (*Betula lutea* Michx.), white birch or paper birch (*B. papyrifera* Marsh.), white oak (*Quercus alba* L.), red maple (*Acer rubrum* L.), sugar maple or hard maple (*A. saccharum* Marsh.), shagbark hickory (*Carya ovata* (Mill.) K. Koch), American beech (*Fagus grandifola* Ehrh.), and white ash (*Fraxinus americana* L.). The conifers were more common at higher altitudes and the hardwoods at lower altitudes. In cut-over land, white pine, quaking aspen (*Populus tremuloides* Michx.), pin cherry (*Prunus pensylvanica* L.), and oak sprouts come in first. In some sandy areas the second growth is a pure stand of even-aged white pine, and on the heavier textured soils at low altitudes oak and red maple predominate. In pastures and on abandoned farms hardhack (locally called steeplechase) and juniper sprouts soon become pests.

In 1771 the Province of New Hampshire was divided into five counties, one of which was Cheshire. At that time Cheshire County also included what is now Sullivan County. The present county boundaries were established in 1827, when the northern 15 towns were taken to form Sullivan County. The first settlements were made at Winchester in 1734, at Keene in 1736, and at Charlestown in 1740. These settlements were abandoned in 1747, owing to Indian wars, but were reestablished in 1750. After this, settlement in other districts proceeded rapidly. The early settlers came from Massachusetts, as the territory was then considered a part of that colony (*8*). Until comparatively recently the people were natives of English ancestry, but, since the development of manufacturing, many people of other nationalities, principally French Canadians, have come into these counties. In 1940 the population of Cheshire County was 34,953, of which 39.6 percent was urban, and that of Sullivan County was 25,442, of which 68.6 percent was urban.

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[4] Italic numbers in parentheses refer to Literature Cited, p. 82.

Keene, having a population of 13,832, is the county seat of Cheshire County; and Newport, with a population of 5,304 in 1940, is the county seat of Sullivan County. Other important towns in Cheshire County are Winchester, with a population of 2,275, Walpole 2,400, Jaffrey 2,879, Swanzey 2,262, and Hinsdale 1,762; and in Sullivan County, Claremont 12,144, Charlestown 1,756, and Sunapee 1,071.[5]

These towns with their industrial and tourist population afford good local markets for produce and milk, and fluid milk is concentrated at North Walpole and shipped daily by motortruck to Boston. Potatoes and poultry products also are shipped to Boston and other cities in Massachusetts.

Several branch lines of the Boston & Maine Railroad provide adequate railroad facilities. Tar-surfaced highways reach every town, allowing motortruck and automobile transportation during all seasons. In general, the country roads are good and well kept, but some sections in thinly settled districts become impassable during the winter and spring. Rural delivery of mail reaches all farms. Schools and churches are well distributed and accessible to all residents. Children living a long distance from schools are transported to school by the school district or are boarded near a school. Telephone service is available to most farms, but some remote and thinly populated districts are not served. Many farms have running water, and some villages have extended mains several miles into rural districts in order to provide water for private use and as a protection from fire.

Many industrial establishments, such as shoe factories, cotton and woolen mills, machine and tool factories, furniture factories, feldspar mines, and box and bucket mills, and many smaller factories, give employment to a large part of the population and part-time employment to many persons living on farms. In addition, many farmers and members of their families spend several months each year cutting wood and working in sawmills. The tourist trade is an important source of revenue to many farms situated along heavily traveled highways, and many of the towns are noted resorts and have many summer residents. In fact, one of the most valuable assets of New Hampshire is the recreational value of the lakes, timbered hills, and mountains, with the vista offered by open fields.

CLIMATE

The climate of southwestern New Hampshire is continental; that is, it has warm summers and cold winters unmodified by the influence of any large body of water. The summers are pleasant, with few very hot days, and more than three consecutive days of hot weather are rare. The data presented in tables 1 and 2 give a clear picture of conditions at the lower elevations.

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[5] Cheshire County is divided into 22 towns and one city, Keene. Sullivan County is divided into 15 towns. For census purposes, however, Claremont and Newport Towns are considered urban. Hereafter, to avoid repetition, the word "town" will be omitted where this can be done without confusion. The town of Claremont, for example, will be referred to as Claremont.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Cavendish, Windsor County, Vt.*

[Elevation, 800 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1908)	Total amount for the wettest year (1938)	Snow, average depth
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*	*Inches*
December	22.1	61	−42	2.80	2.71	4.63	15.0
January	18.1	61	−35	2.88	1.25	4.80	16.4
February	18.1	60	−34	2.55	3.18	2.12	18.4
Winter	19.4	61	−42	8.23	7.14	11.55	49.8
March	29.5	74	−27	3.16	1.74	1.57	12.5
April	41.8	92	−2	2.98	1.23	3.16	6.5
May	53.8	94	20	3.34	6.65	3.28	.2
Spring	41.7	94	−27	9.48	9.62	8.01	19.2
June	62.7	100	28	3.76	1.36	2.25	.0
July	67.8	102	36	4.10	2.34	9.21	.0
August	64.8	99	30	3.23	5.34	4.48	.0
Summer	65.1	102	28	11.09	9.04	15.94	.0
September	57.9	97	21	3.66	1.23	10.76	.0
October	47.0	89	9	3.13	1.33	2.06	.3
November	34.5	75	−6	3.26	.85	3.15	.3
Fall	46.5	97	−6	10.05	3.41	15.97	6.6
Year	43.2	102	−42	38.85	29.21	51.47	75.6

TABLE 2.—*Normal monthly, seasonal, and annual temperature and precipitation near Keene, Cheshire County, N. H.*

[Elevation, 550 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1894)	Total amount for the wettest year (1897)	Snow, average depth
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*	*Inches*
December	24.8	62	−27	2.96	2.77	5.17	11.4
January	20.7	60	−32	2.70	1.91	2.55	15.6
February	21.0	64	−27	2.77	2.20	1.79	17.2
Winter	22.2	64	−32	8.43	6.88	9.51	44.2
March	32.5	82	−15	3.13	1.21	4.08	10.3
April	43.8	88	1	2.85	1.68	2.74	3.4
May	55.4	93	21	3.10	3.48	3.62	(1)
Spring	43.9	93	−15	9.08	6.37	10.44	13.7
June	63.6	98	29	3.16	2.49	5.71	.0
July	68.9	104	36	3.82	2.56	10.19	.0
August	66.2	99	33	3.93	1.05	4.01	.0
Summer	66.2	104	29	10.91	6.10	19.91	.0
September	59.4	94	19	3.43	3.55	1.77	.0
October	48.7	88	14	2.73	2.18	1.86	.1
November	36.5	73	−6	3.01	2.04	6.04	4.0
Fall	48.2	94	−6	9.17	7.77	9.67	4.1
Year	45.1	104	−32	37.59	27.12	49.53	62.0

[1] Trace.

The average frost-free season at the United States Weather Bureau station at Cavendish, in Windsor County, Vt., extends from May 29 to September 15, a period of 109 days, although frost has been recorded as late as June 29 and as early as August 25. Near Keene the average frost-free period extends from May 25 to September 19, a period of 117 days, although frost has been recorded as late as June 21 and as early as August 25.

On the plateaus and ridges the temperature averages a few degrees lower, but the average growing season is longer, as killing frosts may occur 1 or 2 weeks later or earlier in the valleys. Wide variations from normal or average conditions are not common. The rainfall is adequate and well distributed, and crops are seldom injured from drought, even on sandy soils. Destructive storms, such as hailstorms and windstorms, are very infrequent. Tillage operations cannot be carried on between December 1 and April 1, but plowing usually can be done in November.

AGRICULTURAL HISTORY AND STATISTICS

Cheshire and Sullivan Counties were settled and cleared rapidly as soon as danger of Indian raids was past. The rural population increased rapidly until about 1820, remained practically stationary from that time until about 1850, declined rapidly during the next 30 years, and declined more slowly after 1880. An example of this trend in population is Richmond in Cheshire County, a typical rural New England town, which had nearly 1,400 inhabitants in 1820, 1.274 in 1850, 660 in 1880 (*2*), and only 296 in 1940.

A general or subsistence type of farming has always been practiced, but in recent years dairying and poultry raising are being emphasized. A typical subsistence farm in another part of the State (*11*), representative of most farms in these counties in former times and still common today, includes three-quarters of an acre in corn, three-quarters of an acre in small grain, three-quarters of an acre in potatoes, and 24 acres in hay. Three cows are usually kept. Operators of such farms depend on work in the woods or other work for additional income. Many such farms have been abandoned, (pl. 1, *A*), some of them so long ago that trees 12 inches in diameter are growing in the holes remaining from former cellars.

The number and size of farms and the total area of farm land and improved land have decreased steadily from 1880 to 1940 in both counties, as the poorer, stonier, and more inaccessible farms and fields have been abandoned. In Cheshire County during this period the number of farms decreased from 2,836 to 1,557, the area in farms from 88.8 percent to 36.2 percent of the total area of the county, the average size of farms from 146 acres to 106.7 acres, and improved land from 82.5 acres to 32.2 acres to the farm. In Sullivan County the number of farms decreased from 2,306 to 1,285, the area in farms decreased from 83.3 percent to 46.1 percent, the average size of farms increased slightly from 122 acres to 123.2 acres, but the improved land decreased from 89.3 acres to 32.7 acres to the farm.

Table 3 gives the acreages of important crops in census years since 1879 for Cheshire and Sullivan Counties. The most striking feature of this table is the reduction in the acreage in corn and oats. In

general, average acre yields have increased considerably. Much of this increase can be accounted for by abandonment of poorer fields. Better agricultural practices have been adopted, especially in the culture of potatoes, and several farmers report yields of more than 300 bushels an acre.

TABLE 3.—*Acreages of the principal crops in Cheshire and Sullivan Counties, N. H., in stated years*

Crop	1879	1889	1899	1909	1919	1929	1939
CHESHIRE COUNTY							
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Corn:							
For grain	3,834	3,051	3,072	2,833	1,925	421	418
For silage and other purposes					[1] 1,167	864	984
Oats:							
For grain	2,535	2,544	1,182	1,092	1,312	101	128
Cut and fed unthreshed						99	152
Wheat	176	16		4	108	1	18
Potatoes	1,878	1,654	1,413	1,196	1,361	347	420
Tobacco		55	109	79	106	116	6
All hay	59,169	59,171	51,774	41,825	33,165	21,915	24,064
Timothy and clover, alone or mixed				24,730	19,630	13,774	12,422
Alfalfa				9	101	447	198
Small grain for hay			1,054	877	1,042	254	498
Other tame hay			49,849	14,987	12,051	7,184	10,169
Wild hay			871	1,222	341	256	777
SULLIVAN COUNTY							
Corn:							
For grain	3,432	2,779	2,892	2,317	1,208	281	324
For silage and other purposes						878	1,166
Oats:							
For grain	2,896	3,176	1,341	1,238	1,593	210	126
Cut and fed unthreshed						234	343
Wheat	922	138	4	4	117	4	
Potatoes	1,795	1,388	1,085	1,106	989	534	401
All hay	56,665	55,296	46,577	43,039	36,838	31,251	29,126
Timothy and clover, alone or mixed				19,794	24,920	19,110	10,543
Alfalfa			1	1	20	82	123
Small grain for hay			647	973	867	284	686
Other tame hay			45,116	21,928	10,674	11,700	17,119
Wild hay			813	343	357	75	655

[1] For forage only.

In addition to the crops listed in table 3, Cheshire County reported 120 acres in sweet corn and 158 acres in other vegetables harvested for sale in 1929, and 58 acres in sweet corn and 61 acres in other vegetables in 1939. Sullivan County reported 99 acres in sweet corn and 93 acres in other vegetables harvested for sale in 1929, and 34 acres in sweet corn and 97 acres in other vegetables in 1939. Apples are the chief fruit in both counties. In 1940 there were 18,846 trees that produced 39,444 bushels in Cheshire County, and 5,038 trees that produced 7,983 bushels in Sullivan County. Although corn can be matured as grain in most places, it is usually made into silage. When grown for grain, corn yields an average of about 40 bushels an acre, and when cut for silage it yields about 12 tons. Oats are usually cut green, yielding about 2 tons of hay to the acre. Potatoes return an average yield of about 250 bushels an acre, but 350 bushels or more can be obtained in normal seasons with proper fertilization and spraying. A common rotation is corn, oats, potatoes, oats, and hay, which is usually allowed to run for several years. The first two or three crops of hay yield about 2

tons an acre, and on the better farms the sod is plowed after three crops are cut.

Fertilizer is applied to the potato fields at the rate of about 1,000 pounds of 8–16–14 [6] or 1,500 to 2,000 pounds of 4–8–7, 4–8–5, 5–8–7, or other comparable formula, to the acre, and, when planting oats, at the rate of 200 pounds of 4–12–4. Manure is applied to the sod before plowing for corn and is often applied to the hay land as top dressing. On cornland as much as 25 loads with a 38-bushel spreader are applied, and 15 to 20 loads may be spread on hay land. Most farmers use from 300 to 500 pounds of superphosphate or a complete fertilizer (such as 4–12–4) when planting corn, and some broadcast the superphosphate and apply 100 or 200 pounds of complete fertilizer with the planter. Very little lime is used, especially on potato fields, but excellent results have been obtained from the use of lime for crops other than potatoes.

The most popular varieties of corn are West Branch Sweepstakes, Lancaster Surecrop, Gold Nugget, and Cornell 11. Cornell 11 and local flint varieties of corn are commonly planted when mature corn is desired, and the others are planted for silage. The most common varieties of oats are Swedish Select, Cornellian, and Ithacan. Green Mountain and Irish Cobbler are the most common varieties of potatoes grown. Certified seed potatoes, most of which are grown in northern New Hampshire, are purchased each year.

The number of livestock other than poultry is decreasing.

In Cheshire County on April 1, 1940 there were 1,041 horses, 6 mules, and 8,579 cattle over 3 months of age; 540 sheep over 6 months of age; and 693 swine over 4 months of age on farms—a substantial decrease from the numbers reported on April 1, 1930, which were 1,558 horses, 14 mules, 8,987 cattle, 964 sheep, and 902 swine (the latter being over 3 months of age instead of 4 months, as enumerated in the later census). The production of milk decreased correspondingly from 3,162,783 gallons in 1929 to 2,985,525 gallons in 1939. Of the milk produced in 1939, 2,054,674 gallons was sold as fluid milk.

On the other hand, poultry products increased in importance in Cheshire County. In 1939, 940,131 dozen eggs were produced and 310,504 chickens were raised, as compared with 590,228 dozen eggs and 159,911 chickens in 1929.

Similar trends in livestock raising prevailed in Sullivan County, where 1,211 horses, 7 mules, and 10,295 cattle, over 3 months old, 968 sheep over 6 months old, and 946 swine over 4 months old were reported on April 1, 1940. Comparable numbers in 1930 were 1,812 horses, 14 mules, 10,610 cattle, 1,775 sheep, and 775 swine (the latter being over 3 months of age). The decrease in the production of milk was slight—from 2,962,167 gallons in 1929 to 2,892,005 gallons in 1939. In the latter year 1,979,893 gallons was sold as fluid milk. Poultry products in 1939 consisted of 438,246 dozen eggs and 114,077 chickens, representing slight increases as compared with production in 1929, when 409,865 dozen eggs were produced and 101,957 chickens raised.

Table 4 shows the principal sources of farm income. The most important feature of this table is the increase in the value of dairy

[6] Percentages, respectively, of nitrogen, phosphoric acid, and potash.

products and poultry since 1910. They reflect the high price level of 1920, as acreage and production in that year were not higher than in other years.

TABLE 4.—*Value of selected agricultural products in Cheshire and Sullivan Counties, N. H., for stated years*

CHESHIRE COUNTY

Item	1910	1920	1930	1940
Crops:				
Cereals	$109,122	$197,819	$25,964	$18,230
Other grains and seeds	2,215	9,567	1,197	430
Hay and forage	643,425	1,056,970	381,252	353,785
Vegetables (including all potatoes)	[1] 159,658	[1] 449,537	95,167	216,789
Fruits and nuts	78,663	154,957	45,689	39,137
All other field crops	[2] 387,944	[2] 85,988	100,026	15,431
Farm garden vegetables (excluding potatoes)			53,359	131,378
Forest products			222,168	[3] 184,720
Nursery products			36,875	(4)
Livestock products:				
Dairy products sold	433,873	662,603	678,251	478,987
Poultry and eggs produced	207,712	243,255	501,750	525,903
Wool shorn	4,082	9,014	2,111	598
Honey produced	887	1,300	1,143	523

SULLIVAN COUNTY

Item	1910	1920	1930	1940
Crops:				
Cereals	$100,425	$162,495	$23,765	$15,576
Other grains and seeds	3,013	4,806	920	599
Hay and forage	532,029	1,115,652	423,512	406,266
Vegetables (including all potatoes)	[1] 133,302	[1] 312,490	135,498	109,547
Fruits and nuts	50,155	139,792	53,489	16,645
All other field crops	[2] 320,256	[2] 97,757	51,185	21,879
Farm garden vegetables (excluding potatoes)			62,250	62,881
Forest products			317,166	[3] 157,872
Nursery products			19,120	(4)
Livestock products:				
Dairy products sold	291,487	578,089	618,114	431,259
Poultry and eggs produced	152,614	232,733	343,008	217,033
Wool shorn	8,181	9,963	4,589	1,290
Honey produced	1,711	3,472	760	517

[1] All vegetables. [2] All other crops. [3] Forest products sold. [4] Not reported.

The average values of farm land and buildings in 1940 were $4,517 a farm and $42.33 an acre in Cheshire County, and $3,402 a farm and $27.62 an acre in Sullivan County.

Fertilizers are used on about one-half of the farms. In 1939, 513 farms in Cheshire County reported $20,867, and 636 farms in Sullivan County reported $19,731 spent for this amendment. Much of it is purchased through cooperative organizations.

Commercial feed is used on about 85 percent of the farms and is usually bought ready mixed. The total expense for hay, grain, and other feed in 1939 was $546,362 reported by 1,051 farms in Cheshire County and $374,136 reported by 1,002 farms in Sullivan County. Many poultry raisers buy all their feed.

Most farm families do all the general work on the farm, and some hire labor during harvest. A few of the larger farms and dairies keep one or several hands throughout the year. Many farmers exchange work with neighbors, and thus avoid the hiring of help. When a man is hired by the year, the usual rate of pay is $40 a month with board, room, and laundry, or, if married, with house rent, fuel (wood cut on the farm), milk, and vegetables. Farm wages of $428,-

132 were reported paid on 537 farms in Cheshire County, and $208,-267 on 467 farms in Sullivan County in 1939.

About 90 percent of the farms are operated by owners, but many of these farmers rent additional hay or pasture land. When whole farms are rented, the usual contract specifies that each party shall pay half the expenses, and each receive half the proceeds; but when only a field is rented the rent is usually paid in cash.

SOIL SURVEY METHODS AND DEFINITIONS

A soil survey is an inventory of the agricultural resources of an area. The soil is the basis of all agriculture, and the soil survey identifies, classifies, maps, and evaluates the different soils and soil conditions in the area considered. In Sullivan and Cheshire Counties, topographic sheets of the United States Geological Survey are used as the base maps, and areas of the different soils and soil conditions are located on these.

The soils are examined systematically in many locations. Test pits are dug, borings are made, and exposures, such as those in road cuts, gravel pits, and gullies, are studied. Each excavation exposes a series of distinct soil layers or horizons, called collectively the soil profile. Each horizon of the soil, as well as the parent material beneath the soil, is studied in detail. The color, texture (size of individual soil particles), structure (arrangement of the particles), porosity, consistence, reaction,[7] and content of roots, gravel, and stones are noted. Drainage, both internal and external, and other features, such as percent of slope and the interrelation of soil and vegetation, are studied.

The soils are classified according to characteristics, with special emphasis upon the features that influence the adaptation of the land for the growing of crop plants, grasses, and trees. On the basis of these characteristics the soils are grouped into classification units, the three principal of which are (1) series, (2) type, and (3) phase. In some places two or more of these units may occur in such intimate or mixed pattern that they cannot be shown separately on a small-scale map, and are mapped as (4) a complex. Some areas of land, such as marshes and bare, rocky mountainsides, that have no true soil, are called (5) miscellaneous land types.

The most important of these units is the soil series, which includes soils having the same genetic horizons, similar in their important characteristics and arrangement in the soil profile, and having similar parent material. Thus, the series comprises soils having essentially the same color, structure, natural drainage conditions, and other important characteristics, and the same range in relief. The series are given geographic names taken from the location at or near which the soils were first recognized. Hadley, Charlton, Gloucester, and Hinckley are names of important soil series in Cheshire and Sullivan Counties.

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[7] The reaction of the soil is its degree of acidity or alkalinity and is expressed mathematically as the pH value. A pH of 7.0 indicates neutrality; higher values, alkalinity; and lower values, acidity. Indicator solutions are used to determine the reaction of the soil. The presence of lime (calcium carbonate) in the soil is detected by the use of a dilute solution of hydrochloric acid.

A, Abandoned farmhouse near Springfield, N. H., typical of many in this district, except that most of the houses are not so large.
B, Cleared and uncleared stony land showing stone walls in Sunapee, N. H.

A, Better than average farm at Ryder Corner, on Essex and Peru soils.
B, View at Springfield, showing Essex soils in the foreground and Hermon soils on the hillside.
C, View of Hermon and Essex soils in Sunapee, the steep phase of Hermon soil in the background.

The texture of the surface soil, or the depth to which it is commonly plowed, may vary within a series. The class name of this texture, such as sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, or clay, is added to the series name to give the complete name of a soil type. For example, Hinckley gravelly fine sandy loam and Hinckley loamy sand are soil types within the Hinckley series. Except for the texture of the surface soil, these types have approximately the same internal and external characteristics. The soil type is the principal unit of mapping, and because of its specific character, it usually is the soil unit to which agronomic data are referred.

A phase of a soil type is a variation within the type, differing from the type in some minor characteristic that may have practical significance. Differences in relief, stoniness, and degree of erosion may be shown as phases of a soil type. Even though the soil profile is similar, slight differences in these characteristics may greatly affect the use of machinery or the value of the land for producing crops.

The soil surveyor makes a map of the area, showing the location of each of the soil types, phases, complexes, and miscellaneous land types, in relation to roads, houses, streams, lakes, section and township lines, and other local cultural and natural features of the landscape.

SOILS AND CROPS

In Cheshire and Sullivan Counties the soils and their capacity to produce crops vary widely. The soils have developed partly from more or less weathered glacial till, some of which is hard and platy, and partly from alluvial deposits. With the exception of a few areas of the Charlton, Woodbridge, and Blandford soils, all the upland areas were originally stony, and the stones were picked off and placed in walls, or fences, when the land was prepared for cultivation (pl. 1, *B*). Stoniness was not so serious a drawback in former years when much of the work was done by hand as it is now when machinery is used extensively.

The use suitability of the soils is reflected by their present use, since the farms situated on the better soils are the only ones that have survived as self-supporting units. Many homes are maintained on the less productive soils by additional income obtained from wood cutting or other off-the-farm labor, from raising poultry on purchased feed, or from boarding summer visitors.

Large areas are timbered, and only along the Connecticut River, along some of its larger tributaries, and in the vicinity of the larger cities and villages are there extensive cultivated areas. Most fields are small and irregular. Many of the farmers produce milk and some vegetables for local consumption and for shipment. On many farms potatoes and poultry are produced for cash. The primary concern on most farms, however, is the production of hay and forage for livestock, and the soils that support the best mowings and pastures are the most desirable. The general practice is to allow the fields to remain in hay as long as a fair annual yield—about 1 ton an acre—is obtained.

Most fields are situated entirely on one type of soil. In many places soil boundaries are drawn along field boundaries because many nonstony soils were made so by clearing stones from fields and using them for fences.

In the following pages statements are made regarding the relative erodibility of the various soil types. Erosion is not a serious problem in this area, because a very small part of the total area is planted to cultivated crops and most of the cultivated fields are covered by weeds or stubble during the winter and early spring. If a change were made in agronomic practices so that a larger part of the area were planted to row crops, great care would need to be exercised to control erosion. There are a few severely eroded fields, most of which are on farms specializing in the production of potatoes; but no instance was noted where erosion had caused a farm to be abandoned.

For convenience in discussion, the soils of the two counties are grouped: First, largely on the basis of physiography or land forms; and second, on the basis of the character of the parent materials. The major groups are (1) soils of the rolling and hilly uplands; (2) soils of the kames and wind-blown deposits; (3) soils of the nearly level terraces and outwash plains; (4) soils of the bottom lands; (5) organic soils; (6) rough stony lands; and (7) gravel pits.

Within any of the physiographic divisions of the counties most of the soils are readily grouped into (1) soils with fine-textured and in some instances compact parent materials and (2) soils with coarse-textured parent materials. A large area of nonagricultural land is shown on the map as several types of rough stony land.

The most desirable agricultural soils are those developed from fine-textured parent materials where drainage conditions are good, but some of the phases of these soils are suitable only for pasture. The soils developed from coarse-textured materials are less desirable as cropland and in most but not all places are used as pasture or wood lots. The soils with fine-textured but compact substrata are, on the basis of use, the most important agricultural soils in the area, and probably more than 75 percent of the crops in the two counties are grown on them. Large areas of these soils are gently rolling, both in the glaciated uplands and on the terraces and glacial outwash plains; but some steep areas are included. They are excellent soils for the production of corn, oats, and potatoes, and they support native pastures capable of sustaining one cow on 2 acres. Excellent pastures of Kentucky bluegrass (commonly called junegrass), redtop, sweet vernalgrass, and bentgrasses are obtained where the land is well managed. Very little attention is paid to the permanent pastures, however, and a large proportion—in places almost all—of the pastures is taken up by hardhack (steeplechase), sweetfern, and juniper.

Erosion is not a serious problem, as a very small proportion of the area occupied by these soils is plowed each year, and fall plowing is practiced only on the more nearly flat areas. The compact subsoil impedes and in many places practically prevents the downward movement of water, so that the friable part of the soil soon becomes

saturated. If the soils were bare during a long rainy period, sheet erosion and gullying would be very rapid. These soils warm very slowly in the spring, but generally they can be worked by the middle of May. A small proportion, probably less than 20 percent, of the total area occupied by these soils is cultivated, and from 10 to 15 percent is used as pasture. Many areas are situated on poor roads, are in isolated districts, or are too stony or too steep to be farmed profitably.

In the following pages the soils are described in detail, and their agricultural relations are discussed; their acreage and proportionate extent are given in tables 5 and 6; and their distribution is shown on the accompanying soil map.

TABLE 5.—*Acreage and proportionate extent of the soils mapped in Cheshire County, N. H.*

Type of soil	Acres	Percent
Charlton loam	9,792	2.2
Charlton loam, steep phase	256	.1
Charlton stony loam	10,048	2.2
Charlton stony loam, steep phase	4,032	.9
Hollis loam	1,984	.4
Hollis stony loam	8,768	1.9
Hollis stony loam, steep phase	1,152	.3
Woodbridge loam	7,488	1.7
Woodbridge loam, steep phase	896	.2
Woodbridge stony loam	1,152	.3
Woodbridge stony loam, steep phase	1,856	.4
Marlow loam	12,992	2.9
Marlow stony loam	26,624	5.9
Marlow stony loam, steep phase	6,848	1.5
Blandford loam	512	.1
Sutton silt loam	320	.1
Essex loam	2,816	.6
Essex stony loam	3,328	.7
Essex stony loam, steep phase	576	.1
Peru stony loam	2,880	.6
Whitman stony loam	7,104	1.6
Gloucester fine sandy loam	8,320	1.8
Gloucester stony fine sandy loam	45,568	10.1
Gloucester stony fine sandy loam, steep phase	4,160	.9
Shapleigh sandy loam	448	.1
Shapleigh stony sandy loam	6,336	1.4
Hermon stony sandy loam	64	(1)
Brookfield loam	832	.2
Brookfield stony loam	8,704	1.9
Brookfield stony loam, steep phase	1,088	.3
Brookfield stony loam, shallow phase	8,640	1.9
Hinckley loamy sand	576	.1
Hinckley gravelly fine sandy loam	4,224	.9
Danby loamy sand	5,248	1.2
Danby gravelly sandy loam	11,840	2.6
Danby gravelly fine sandy loam	2,432	.5
Jaffrey gravelly sandy loam	1,664	.4
Windsor loamy fine sand	1,664	.4
Windsor loamy fine sand, eroded phase	64	(1)
Suffield silt loam	64	(1)
Melrose fine sandy loam	64	(1)
Agawam fine sandy loam	1,536	.3
Agawam very fine sandy loam	1,088	.3
Agawam loamy fine sand	1,664	.4
Agawam loamy fine sand, broken phase	3,264	0.7
Merrimac fine sandy loam	1,984	.4
Merrimac gravelly fine sandy loam	2,688	.6
Merrimac loamy sand	5,056	1.1
Merrimac gravelly loamy sand	1,408	.3
Merrimac gravelly loamy sand, broken phase	768	.2
Adams loamy fine sand	1,664	.4
Colton sandy loam	832	.2
Colton gravelly sandy loam	896	.2
Colton loamy sand	1,280	.3
Sudbury fine sandy loam	512	.1
Hadley very fine sandy loam	896	.2
Hadley very fine sandy loam, low-bottom phase	192	(1)
Hadley loamy fine sand, low-bottom phase	320	.1
Podunk-Rumney fine sandy loams	2,880	.6
Podunk-Rumney silt loams	2,432	.5
Ondawa fine sandy loam	4,032	.9
Ondawa fine sandy loam, high-bottom phase	1,024	.2
Ondawa loamy fine sand	1,408	.3
Alluvial soils, undifferentiated	9,664	2.1
Muck	576	.1
Peat	19,520	4.3
Peat, shallow phase	128	(1)
Rough stony land (Hollis soil material)	23,104	5.1
Rough stony land (Gloucester soil material)	27,072	6.0
Rough stony land (Marlow soil material)	20,928	4.6
Rough stony land (Brookfield soil material)	22,016	4.9
Rough stony land (Essex soil material)	2,048	.5
Rough stony land (Shapleigh soil material)	60,864	13.4
Rough stony land (Hermon soil material)	64	(1)
Rough stony land (Canaan soil material)	4,224	.9
Rock outcrop	1,664	.4
Total	453,120	100.0

[1] Less than 0.1 percent.

TABLE 6.—*Acreage and proportionate extent of the soils mapped in Sullivan County, N. H.*

Type of soil	Acres	Per-cent
Charlton loam	17,600	5.1
Charlton loam, steep phase	1,728	.5
Charlton stony loam	17,600	5.1
Charlton stony loam, steep phase	11,648	3.4
Hollis loam	7,488	2.2
Hollis loam, steep phase	1,536	.4
Hollis stony loam	18,560	5.4
Hollis stony loam, steep phase	13,184	3.8
Woodbridge loam	7,296	2.1
Woodbridge loam, steep phase	960	.3
Woodbridge stony loam	6,336	1.9
Woodbridge stony loam, steep phase	2,560	.7
Blandford loam	4,160	1.2
Sutton silt loam	2,752	.8
Essex loam	6,848	2.0
Essex stony loam	18,240	5.3
Essex stony loam, steep phase	11,648	3.4
Peru stony loam	7,936	2.3
Whitman stony loam	6,336	1.9
Gloucester fine sandy loam	1,920	.6
Gloucester stony fine sandy loam	17,344	5.1
Gloucester stony fine sandy loam, steep phase	5,952	1.7
Shapleigh sandy loam	1,024	.3
Shapleigh stony sandy loam	6,208	1.8
Shapleigh stony sandy loam, steep phase	128	[1]
Hermon stony sandy loam	576	.2
Hermon stony sandy loam, steep phase	1,408	.4
Canaan stony sandy loam	576	.2
Brookfield loam	1,216	.4
Brookfield stony loam	2,496	.7
Brookfield stony loam, steep phase	1,088	.3
Brookfield stony loam, shallow phase	6,016	1.8
Hinckley loamy sand	192	.1
Hinckley gravelly fine sandy loam	2,112	.6
Danby loamy sand	3,584	1.0
Danby gravelly sandy loam	3,712	1.1
Danby gravelly fine sandy loam	3,328	1.0
Windsor loamy fine sand	384	.1
Windsor loamy fine sand, eroded phase	448	.1
Suffield silt loam	832	.2
Hartland very fine sandy loam	1,600	.5
Hartland very fine sandy loam, broken phase	256	.1
Melrose fine sandy loam	320	.1
Agawam fine sandy loam	1,792	0.5
Agawam very fine sandy loam	1,024	.3
Agawam loamy fine sand	1,088	.3
Agawam loamy fine sand, broken phase	832	.2
Merrimac fine sandy loam	2,176	.6
Merrimac gravelly fine sandy loam	2,560	.7
Merrimac loamy sand	512	.1
Merrimac gravelly loamy sand, broken phase	1,088	.3
Adams loamy fine sand	768	.2
Colton sandy loam	1,856	.5
Colton gravelly sandy loam	768	.2
Colton loamy sand	1,024	.3
Sudbury fine sandy loam	192	.1
Hadley very fine sandy loam	1,024	.3
Hadley very fine sandy loam, low-bottom phase	64	[1]
Hadley loamy fine sand, low-bottom phase	256	.1
Podunk-Rumney fine sandy loams	1,856	.5
Podunk-Rumney silt loams	1,024	.3
Ondawa fine sandy loam	2,304	.7
Ondawa fine sandy loam, high-bottom phase	960	.3
Ondawa loamy fine sand	576	.2
Alluvial soils undifferentiated	5,888	1.7
Muck	1,280	.4
Muck, shallow phase	192	.1
Peat	5,632	1.6
Peat, shallow phase	64	[1]
Rough stony land (Hollis soil material)	29,120	8.5
Rough stony land (Gloucester soil material)	22,336	6.5
Rough stony land (Marlow soil material)	640	.2
Rough stony land (Brookfield soil material)	1,920	.6
Rough stony land (Essex soil material)	1,792	.5
Rough stony land (Shapleigh soil material)	4,736	1.4
Rough stony land (Hermon soil material)	15,616	4.6
Rough stony land (Canaan soil material)	2,112	.6
Rock outcrop	1,472	.4
Total	343,680	100.0

[1] Less than 0.1 percent.

SOILS OF THE ROLLING AND HILLY UPLANDS

The uplands of Cheshire and Sullivan Counties present a beautiful rolling to hilly country, much of which is covered by mixed forests or nearly pure stands of hardwoods or pines. Where the glacial deposits are fine-textured and more or less compact, much of the land is gently rolling and suitable for agriculture. Where the deposits are coarse, on the other hand, a larger proportion of the land is rough and stony and suitable only for forestry and pasture. On the bases of these differences, the soils of the rolling and hilly uplands are placed in two subgroups: (1) Soils over compact fine-textured glacial till and (2) soils over firm coarse-textured glacial till.

SOILS OVER COMPACT FINE-TEXTURED GLACIAL TILL

The soils over compact fine-textured glacial till are members of the Charlton, Woodbridge, Hollis, Blandford, Marlow, Essex, Sutton,

Peru, and Whitman series. The common profile in a cultivated field includes a dusky-brown mellow loam surface soil, about 7 inches thick; a yellowish-brown friable loam or silt loam subsoil, extending to a depth of 24 to 30 inches; and, below that, a hard compact platy loam or clay loam substratum.

The Sutton, Peru, and Whitman soils differ from this description in that they occupy imperfectly or poorly drained situations and have mottled gray and brown subsoils and substrata. The reaction is medium to strongly acid throughout. All these soils, with the exception of some areas of the Charlton, Woodbridge, and Blandford soils, were stony when first cleared, and the stones had to be removed by hand. The most common practice was to place the stones in walls, or fences, and most fields are so enclosed. To the early farmer the stones were not a great misfortune, as they provided a rather tight permanent fence. The degree of stoniness determined to some extent the size of the field. Today these fences are a hindrance on many farms, and some effort is being made to remove them. When hand labor is used to remove them it costs from 20 to 25 cents a linear foot to load the stones into trucks and dump them in some less valuable part of the farm. Little or no saving in money can be made by the use of a gasoline shovel. One farmer had a gasoline shovel dig a deep trench beside the wall, place the stones in the trench, and then cover them so that they would not interfere with cultivation. The advantage of this method is that the stones are not occupying land that might be used for other purposes.

The Charlton, Woodbridge, Marlow, and Essex soils have the general profile described above and differ from each other in minor characteristics or in the degree to which certain features are developed. The profile described is typical of the Charlton soils. The rocks from which the Charlton soil material was formed are mostly gray schists. Charlton loam, Charlton stony loam, and steep phases of these soils are mapped in this soil series. The Woodbridge soils differ from the Charlton soils in that the substratum lies about 20 inches below the surface and is very hard and platy. Also, the subsoil in most places is less brown than the subsoil described and in some places is grayish yellow. Woodbridge loam, Woodbridge stony loam, and steep phases of these soils are recognized in the Woodbridge series. The Marlow and Essex soils differ from the other members of this group in that they have moderately compact but somewhat gritty substrata. The substratum of the Marlow soils is composed of compact, platy, fine materials, which have been derived from schist and gneiss, and this occurs at a depth of about 2 feet. It is dark gray or grayish brown in a cut but becomes brownish yellow when crushed. The glacial-till substratum of the Essex soils, derived principally from granitic rocks, is hard and compact. In most places it is lighter gray than the substrata of the other soils in this group. Marlow loam, Marlow stony loam and its steep phase, Essex loam, and Essex stony loam and its steep phase are the soil types and phases mapped in these series.

Typically, bedrock lies at a depth of less than 3 feet beneath the surface of the Hollis soils. In most places, however, the surface of the bedrock is very uneven and not parallel to the surface of the soil; there are numerous outcrops and many small areas in which

the overburden of soil is 6 feet or more thick, and the compact, platy substratum is present. The Hollis soils, as mapped, are developed from complexes of shallow and deep soil materials. Hollis loam, Hollis stony loam, and steep phases of these soils are mapped.

The Blandford soils have developed in the higher altitudes from very fine-grained material. Surface drainage in most places is good, but internal drainage is slow. The surface soil is dark brown or grayish brown, the subsoil is olive or olive yellow, and the substratum is olive-gray heavy material that in most places is platy and hinders the downward movement of water. Blandford loam is the only type mapped.

All the soils in this group, except members of the Sutton, Peru, and Whitman series, are well drained. The Sutton and Peru soils are imperfectly drained and have dark-gray silt loam or loam surface soils about 9 inches thick. In a few places the surface soil is mottled with rust brown and gray. The subsoil to a depth of 20 to 24 inches is brownish-yellow silt loam or loam mottled with grayish yellow, gray, and rust brown. The substratum is hard and compact and in most places contains much silt, but the substratum of some areas of the Peru soil is sandy loam. These soils support excellent pastures and when the stones are removed are well suited to the production of hay but not well suited to row crops, because they warm late in the spring and cultivation is hindered by heavy rains. They occur on nearly flat or slightly convex areas and in many places at the bases of hills. Under virgin conditions they supported a growth of hemlock, red maple (soft maple), and spruce. Sutton silt loam and Peru stony loam are mapped.

The Whitman soils have developed in poorly drained positions associated with all the soils of the uplands. The surface soil to a depth of about 6 or 8 inches is very dark gray or nearly black, and the subsoil to a depth of 10 or 12 inches is dark gray. The substratum is gray mottled with grayish yellow and rust brown. Most of the areas of the Whitman soil are forested, but some of them are used as pasture or hay land. The most common cover on forested areas is willow, alder, spruce, hemlock, and some white birch. Whitman stony loam is mapped in this area.

Charlton loam.—This soil, occurring on low gently rolling hills in the western part of the area, covers 42.8 square miles. The average slope on which it is mapped is about 10 percent, but some areas are on slopes as great as 20 percent. Both external and internal drainage are good, but movement of water through the substratum is slow and a heavy precipitation results in considerable runoff. Except in prolonged periods of severe drought, this soil provides sufficient moisture for the steady growth of plants, and in normal seasons it warms so that it can be plowed early in May.

The 7- or 8-inch surface soil is brown or dark-brown mellow loam that exhibits a very soft crumb structure if handled carefully. The upper part of the subsoil, to a depth of about 15 inches, is light-brown or yellowish-brown loam that is slightly heavier than the surface soil. It is firm in place but very friable. In most places it is massive, but in a few places soft plates have been formed or have been inherited from the parent material. The lower part of the subsoil, between depths of about 15 and 20 inches, is light brownish-yellow

friable loam that in many places is tinted with olive. In most places soft plates are present, but in many exposures the material is massive. Beneath this and extending to a depth of 24 to 30 inches the subsoil is slightly compact and platy grayish-yellow or olive loam containing a few small gray and brown mottlings. In most places the proportion of mottled soil increases with depth until at the lower limit of the layer there is 1 or 2 inches of highly mottled soil. The substratum or parent material is grayish-yellow or olive compact platy fairly heavy till that is brownish yellow if crushed when dry. This material is slightly porous or vesicular, and moisture penetrates it slowly. When moist it is friable and slightly sticky but can be penetrated by sampling tools by the use of moderate force. When dry it becomes rather hard and in many places breaks into angular fragments. This till is derived principally from schist rocks with a slight admixture of granite and gneiss.

The few large stones that were present on the surface when this land was prepared for cultivation have been picked off and placed in walls, but there are many small stone fragments on the surface and in the soil, and a few large boulders occur in the subsoil and substratum. Roots easily penetrate all layers except the substratum, and all horizons are strongly acid, having a pH value of 5.5 to 5.0 (determined with Soiltex).

The profile described above is typical, but in some places the thickness of the subsoil layers varies so that the compact substratum lies at a depth ranging from 20 to 36 inches. In a few places the substratum is friable but firm in place and only slightly compact.

Included with this soil in mapping are several areas north and east of Claremont in which the till substratum has a very smooth silty clay loam texture, very few stones occur in the deeper layers, and very small stone fences surround fairly large fields. Most of the stones are bluish-gray slaty schist, and there are only a few granitic rocks. The substratum in most places is friable, plastic when wet, but very platy and in a few places compact. This heavy-textured substratum occurs in most places at a depth of about 20 inches, and the subsoil layers are less bright and have more gray than in areas of the typical soil. Also included in mapping are small bodies in which small quantities of calcareous schists are incorporated in the parent material. Many of these bodies are in Walpole, but others are in the western part of Alstead, the northern part of Westmoreland and Claremont, and scattered throughout Plainfield and Cornish. The total area influenced by these calcareous schists is about 5 square miles. In these bodies the surface soil and subsoil layers are browner than is typical of Charlton loam, and there are a few brown spots in the substratum where fragments of lime-bearing rock have decomposed. This included soil could have been classified as Colrain loam but the proportion of lime rocks in the mixture was very small, and there is very little noticeable effect on the resulting soil. In a few small areas in the western part of Alstead, near Slade Cemetery, the soil apparently has developed directly from the underlying calcareous bedrock and not from transported material. Both the surface soil and the subsoil are dark brown and have a high content of rounded fine sand grains. The surface soil is strongly acid (pH 5.0), but the subsoil is nearly neutral (pH 6.5). As mapped, Charlton loam also includes a few areas of soil in Westmoreland south of

Westmoreland village where the substratum below a 36-inch depth is very heavy and tightly compact. These areas might be called a deep phase of Woodbridge loam, but owing to the friable character of the upper part of the substratum they are included with Charlton loam.

Practically all of the land is cultivated, and many prosperous farms are situated on it. Corn for silage yields about 16 tons an acre and oats about 40 bushels of grain or about 2 tons of hay if cut green. About 60 percent of the land is in mowing, but very little is used for pasture, because there is an abundance of rough land that can be used for permanent pasture. Clover and timothy are the common hay crops. The yield in new seedings is about 3 tons an acre, and most fields are top-dressed after the second year. Many fields are allowed to stand 4 or more years, but most of them are plowed or top-dressed with manure after the second year. Although most of the farms maintain large dairies and stable manure is the principal source of fertilization, many farmers apply from 300 to 500 pounds of superphosphate or 4–12–4 when planting corn. Some broadcast the superphosphate and then add from 100 to 200 pounds of 4–12–4 with the planter. Most farmers plant a small acreage to potatoes for home use, and a few plant larger acreages for sale. The potato fields are fertilized heavily with an equivalent of 1,000 to 1,500 pounds of 8–16–16. Yields above 300 bushels an acre are obtained, but the average yield is about 250 bushels an acre.

This soil cannot be plowed in the fall, as serious erosion may result between the spring thaw and the time when crops can be planted. Serious erosion will also result if rows are not run approximately on contours.

Charlton loam, steep phase.—The steep phase of Charlton loam has a profile similar to that of the typical soil, but it has a slope steeper than 20 percent. In few places, however, is the slope greater than 25 percent, as steeper land was not cleared of stone in preparation for cultivation. The crop yields and adaptations are similar to those of the typical soil, but greater care must be exercised to control erosion, and the use of modern machinery is difficult.

This soil is associated with Charlton loam. The total area is 3.1 square miles.

Charlton stony loam.—In permanent pastures the profile of Charlton stony loam is like that of Charlton loam, except that stones are numerous enough to impede cultivation seriously if not to preclude it. In areas that have been in forest for 100 years or more, a 3-inch mat of dark-brown or black organic matter covers the surface, and the mineral surface soil to a depth of 1 or 2 inches is gray or nearly white loam or fine sandy loam. This material passes into a 1- or 2-inch layer of very dark-brown or coffee-colored loam, which, in turn, passes into brown loam. This material reaches a depth of about 7 inches. The surface soil and in timbered areas the upper part of the subsoil break into soft granules.

In many places the soil is similar to Berkshire stony loam. The Berkshire soils, however, do not commonly occur at an elevation of less than 2,000 feet, except in more northern latitudes. The deeper part of the soil is similar to the corresponding part of Charlton loam in all respects and has the same variations and inclusions. In

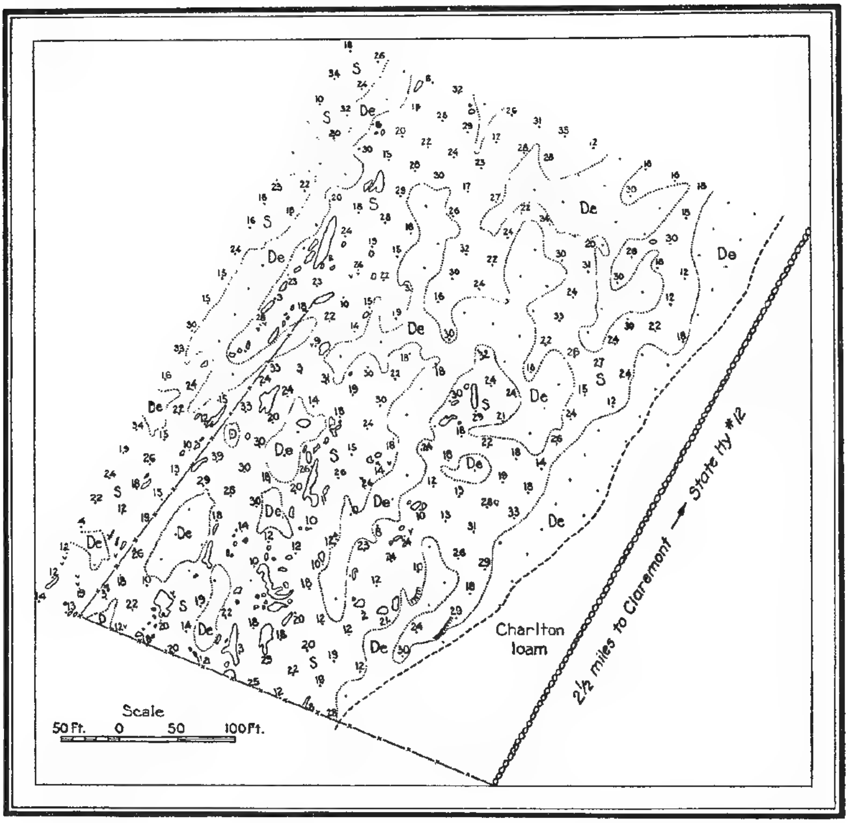
addition, an inclusion is made of several small spots 1 mile south of Alstead Center, each less than 1 acre in extent, where the soil is developed over a thin deposit of gravel, which lies, in turn, on the platy substratum. In some places in this inclusion the soil and gravel have a total thickness of as much as 4 feet.

Charlton stony loam is closely associated with Charlton loam. None of it is cultivated, although much of it probably was cultivated at one time. The total area of Charlton stony loam is 43.2 square miles, and more than half of it is used as permanent pasture. Little or no attention is given the pastures, and in many places juniper, hardhack, moss, and sweetfern are serious pests occupying more than 50 percent of the total area. From 2 to 4 acres of this pasture, depending on the number of stones and pests, is necessary for each cow.

This soil occupies low, gently rolling hillsides and hill crests, where the slope is slightly less than 20 percent. The only areas having nearly level relief are those that are covered with stones or that are isolated or inaccessible from cultivated areas. Where the land is forested the most common trees are white pine, white birch, sugar maple, red oak, and beech.

Charlton stony loam, steep phase.—This soil is similar in all respects to typical Charlton stony loam except that it has a slope greater than 20 percent. In many places the slope is as steep as 30 percent, but the average is about 25 percent. This soil is closely associated with other Charlton soils. None of it is cultivated, and only a small proportion of it is in pasture. If the steeper slopes were pastured, erosion would be serious. The total area is 24.5 square miles.

Hollis loam.—Typically, Hollis loam occurs at a low altitude where less than 3 feet of soil material rests on bedrock. This soil material is similar to that from which the Charlton soils were developed. In this area the relief of the bedrock is very irregular and not parallel to the surface of the soil. Outcrops are numerous. In cultivated fields or in pastures, Hollis loam generally has a dark-brown friable loam surface soil, about 7 inches thick. In a forest that is 100 years old or older, a 2- or 3-inch mat of nearly black decomposed and partly decomposed leaves and twigs is on the surface and the topmost ½- to 2-inch layer of mineral soil is light-gray or nearly white loam or fine sandy loam. This passes abruptly into a 1- or 2-inch layer of very dark-brown or coffee-colored loam, which, in turn, passes into brown or yellowish-brown loam. This material reaches to a depth of 7 inches. Whether cultivated or in timber, the surface soil breaks into soft crumbs. The subsoil, which extends to a depth of about 17 inches, is light-brown friable loam, in most places containing small fragments of schist. In many places this schist includes a large proportion of mica and can be split into very thin plates, although the plates are easily crushed to a structureless mass. The substratum, lying in most places about 24 inches below the surface, consists of brownish-yellow friable loam with many small schist fragments. The reaction is strongly to very strongly acid. In many places this soil is associated in about equal proportions with small areas of a deeper phase of the soil, somewhat like Charlton loam. Figure 2 is a very detailed map of about 5 acres of Hollis loam,



CONVENTIONAL SIGNS

Boundary between Hollis and Charlton loams on Soil Survey field sheet
Boundary between shallow and deep areas
S Shallow areas (less than 36 inches to bedrock)
De Deep areas (36 inches or more to bedrock)
Rock outcrops and ledges
Barbed wire fence
Stone wall
13 Location of soundings marked by dots. Depth to bedrock shown beside location where less than 36 inches

FIGURE 2.—Very detailed map of a 5-acre tract showing bodies of shallow and deep soil material in an area mapped as Hollis loam. (Depths are given at 25-foot intervals where bedrock lies less than 36 inches below the surface.)

showing the relative proportions of deep and shallow soil material. This area, about 2½ miles southwest of Claremont, and approximately rectangular, is considered typical.

The base lines were measured with a tape and stakes set every 25 feet, and lines were run along the northeast axis. Soundings were made every 25 feet. Intervals between soundings were paced, but direction was maintained with a plane table. At stations where bedrock occurred at a depth of less than 36 inches the depth in inches is shown on the sketch map. Soundings were made with a specially

constructed tool made from ½-inch round iron, with a point on one end and with a handle welded 6 inches from the other end. This tool was driven into the ground with a light sledge hammer. There is some possibility of error in this method, as a large fragment of rock that appears to be bedrock may be struck. There is also a slight possibility that the tool may be driven into a crevice or an inch or two into soft, partly decayed rock. Allowance was made for these possible errors by making two or three soundings, about 1 foot apart, at many of the intersections; and where this was done the average depth appears on the map. Boundaries are drawn on the map from the results of these soundings and from surface features, such as growth of grass and contour.

The soil in this area is essentially uniform in all characteristics except depth to bedrock. The surface soil, about 7 inches thick, is very dark-brown silt loam or loam. To a depth of about 20 inches, the subsoil is brown friable silt loam or loam. Beneath this is loose olive-gray fine sandy loam or loam, which extends down to a thin horizon of gray partly disintegrated rock that in most places is less than 2 inches thick and rests on bedrock. There are many small fragments of schist throughout. In areas where the soil mantle is less than 20 inches thick, the olive-gray loam layer is absent and the thickness of the brown subsoil depends on the depth to bedrock. In this area the deeper soil has apparently developed from material that is different from the till from which the Charlton soils in the vicinity have developed. All the soil mapped as Hollis loam in the area covered by this study has apparently developed from till derived almost entirely from phyllitic schist similar to the bedrock underlying it, but the Charlton soils mapped nearby are underlain by greenish-yellow or olive rather heavy, slightly compact and platy loam or silt loam till.

There are a few areas of 10 acres or more each in which typical Hollis loam occurs without its deeper phase. One of these is 4½ miles south of Walpole. Included in some areas are very small spots of Woodbridge loam. In these the surface soil and the subsoil are slightly heavier textured than elsewhere, and the substratum, where present, is very compact and heavy.

Hollis loam is associated with the Charlton soils in the western part of the area. The total area is 14.8 square miles. In most places it occupies steeper areas than does Charlton loam, the average slope being about 15 percent, but some areas are on rounded hilltops where the slope is less than 10 percent.

Surface drainage is good to excessive, and internal drainage is good. During long periods of heavy rainfall, however, the soil becomes temporarily saturated and water cannot penetrate below the rock except through crevices.

Most of the land is now used as pasture, as only the gently sloping areas and those including a comparatively large proportion of the deeper soil are cultivated. At one time all the land was cultivated. Where this soil is cultivated, crop yields and farming practices are almost the same as those on Charlton loam. It is considered excellent pasture land, and many farmers prefer it to Charlton loam for this purpose, as the water-holding capacity appears to be very good. Apparently the irregular surface of the bedrock forms reservoirs that hold the moisture until needed by plants. Hardhack, juniper,

blueberries, and moss have invaded most pastures, and in some they have almost crowded out the bluegrass, redtop, and bentgrass common to the better pastures. An area of 2 to 4 acres, depending on the proportion of outcrops and pests, is required for each cow pastured.

Hollis loam, steep phase.—This soil is similar to typical Hollis loam except that it is mapped where the slope is more than 20 percent. In most places, however, the slope is less than 25 percent. Very little if any of the land is cultivated, but it supports many good pastures. This soil occurs only in Sullivan County. The total area is 2.4 square miles.

Hollis stony loam.—This soil is similar to Hollis loam except that it has sufficient stones on the surface to impede or preclude cultivation with machinery. It is associated with the Charlton soils and Hollis loam, and it comprises 42.7 square miles. None of it is cultivated; most of it is used as pasture, and the rest is in timber. It is as desirable for pasture as Hollis loam in areas of comparably deep soils. Most of the areas, however, include 50 percent or more of the very shallow soil, and grasses cannot get sufficient moisture where there is less than 1 foot of soil. About 60 percent of this soil is in timber. The more common trees are white pine, oak, sugar maple, black cherry, hemlock, white birch, yellow birch, and beech.

Hollis stony loam, steep phase.—This soil is similar to typical Hollis stony loam in every respect except that it has a slope greater than 20 percent. The average slope is about 25 percent. This soil, which is associated with the Charlton soils and other Hollis soils in the western part of the area, covers a total area of 22.4 square miles.

This soil should not be pastured too heavily, especially during periods of heavy rainfall, as severe erosion may result.

Woodbridge loam.—In cultivated fields or pastures the surface soil of Woodbridge loam to a depth of about 6 inches is dark-brown mellow heavy loam having a soft-crumb structure. In forests a 1- or 2-inch organic surface layer of very dark-brown or black partly decomposed organic matter overlies a 2- or 3-inch dark-brown mineral surface layer. In a few places the first half inch of the mineral soil is light-gray or nearly white silt loam. The subsoil, which reaches to a depth of 15 to 18 inches, is grayish-brown or yellowish-brown mellow loam that has a slightly more firm crumb structure than the surface soil. Beneath this and continuing to a depth of 20 to 24 inches the soil is mottled grayish-brown, brown, and rust-brown light loam or fine sandy loam that breaks into firm plates about one-eighth to one-fourth of an inch thick. The substratum is very compact platy clayey till that is almost impervious to penetration by roots and water. The reaction is very strongly acid throughout, as the pH value ranges from 4.5 to 5.0.

During periods of heavy rainfall, small landslides or slips occur in areas of this soil, especially where steep banks border the streams and the heads of small draws.

There are almost no stones on the surface and few in the soil. Most of those that were originally on the surface have been picked off and placed in walls. The walls surrounding fields of this soil are low, and in most places they are composed entirely of schist fragments.

In some places the mottled layer is not present, but the deep subsoil is grayish-yellow or olive loam that breaks into easily crumbled plates. In places where erosion has been active for several years, the dark surface soil has been washed off and the present surface soil is brown loam, and the subsoil layers have become thinner by having been mixed with the remaining surface soil so that in places the compact substratum lies at a depth as slight as 14 inches.

Woodbridge loam occurs on low, smooth hills, associated with the Charlton soils, in the western parts of the counties, but it occurs almost entirely on slopes facing north and west. The total area is 23.1 square miles.

Woodbridge loam has a maximum slope of 20 percent, but the average slope is between 10 and 15 percent. The material from which this soil has developed is derived from schist rocks similar to those giving rise to the Charlton soils. The very compact structure is thought to have been caused by the fact that the glacier overrode this material and put it under very great pressure. One circumstance substantiating this theory is that the soil occurs on the northern and western slopes, and it is known that the glacier proceeded in a southeasterly direction.

This soil is well but not excessively drained. Water moves readily downward through the surface soil and subsoil layers but seeps away horizontally through the mottled layer overlying the substratum. Runoff is rapid, and when the upper part of the soil becomes saturated erosion is very severe. This is the most erodible soil in the area and must be handled very carefully.

Practically all of the land is cultivated or used as pasture, and very little is in forest. Where cultivated, this soil is managed in the same way as Charlton loam. As compared with yields on that soil, yields of corn and oats on Woodbridge loam are slightly lower, but those of hay are equal or slightly higher. Corn for silage yields about 14 tons an acre, oats about 35 bushels, hay about 3 tons, and potatoes frequently as high as 300 bushels. About 40 percent of this soil is used as pasture, and about 40 percent is in mowing. The soil warms very late in the spring, but it has the ability to hold moisture, so that plants are seldom retarded by lack of moisture, even during prolonged dry periods. Manure is the most common soil amendment used. Many farmers also apply from 300 to 500 pounds of superphosphate or 4–12–4 fertilizer an acre to cornland. Potato fields receive as much as 1,500 pounds of 8–16–16 fertilizer an acre. Old mowings sometimes receive a top dressing of manure, but little attention is paid to pasture. If seeded and fertilized, many fields would be capable of supporting one cow to the acre; whereas at present these fields are so largely overrun by hardhack, moss, small brush, and small trees that an area of 3 acres is required to support each cow. The most common trees on forested areas are sugar maple, red oak, beech, gray birch, ash, and white pine.

Woodbridge loam, steep phase.—The steep phase of Woodbridge loam is similar to the typical soil except that it has a slope ranging from 20 to 25 percent and averaging very little more than 20 percent. It is associated with the typical soil and has a total area of 2.9 square miles.

Practically all of the land is used as pasture. It becomes severely eroded if devoted to clean-cultivated crops, and large gullies soon form if the land is pastured too heavily during very wet periods.

Woodbridge stony loam.—Pastured areas of Woodbridge stony loam are similar to pastured areas of Woodbridge loam except that stones are numerous enough on the surface to hinder or prevent cultivation with machinery. In forested areas a 2-inch layer of dark-brown or black organic matter overlies a layer, about 3 inches thick, of mineral soil that is dark-brown loam having a crumb structure. In a few places the first half inch of the mineral soil is light-gray or nearly white silt loam and the dark-brown layer extends to a depth of 4 or 5 inches. The subsoil and underlying platy glacial till are similar to the corresponding layers of Woodbridge loam. This soil is associated with Woodbridge loam and covers a total area of 11.7 square miles. More than half of the land is used as pasture; the rest is in timber. Kentucky bluegrass, redtop, and bentgrasses grow well, and from 2 to 3 acres of pasture, depending on the quantity of stones and weeds or other pests, is required for one cow.

Woodbridge stony loam, steep phase.—This soil is similar to typical Woodbridge stony loam except that it has a slope greater than 20 percent and averaging about 25 percent. It is associated with the Woodbridge and Charlton soils and has a total area of 6.9 square miles. A large proportion of the land is in timber, as much of it is too steep for pasture.

Marlow loam.—This soil resembles Charlton loam in many features but is distinguished from it by a yellower slightly grittier and harder glacial till substratum, and in most places the compact substratum lies 20 to 24 inches beneath the surface. As these soils grade into each other, the boundary between them in most places is somewhat arbitrary. Nevertheless, these soils are recognizably different within the main body of each of them, even though they are not easily distinguished at the line of meeting.

In cultivated fields the 7-inch surface soil is dark-brown loam having very soft crumblike aggregates. In forested areas the surface soil is covered by a 1- or 2-inch layer of very dark brown or black organic matter. The 1- or 2-inch surface layer of mineral soil is gray or nearly white fine sandy loam, which gives way abruptly to very dark-brown or coffee-colored loam, 1 to 1½ inches thick. This, in turn, grades into yellowish-brown loam, which becomes gradually yellower until, at a depth of about 15 inches, the material is brownish yellow. This material rests on grayish-brown or olive-gray partly weathered glacial till 20 to 24 inches below the surface. The subsoil breaks into soft crumblike to fragmental aggregates, and the weathered till breaks into hard fragments. The till is compact and is difficult to remove from a road cut or a pit; but when removed it can be crushed with moderate pressure to a grayish-yellow mealy mass. The less weathered glacial till, at a depth of 30 to 36 inches, is very hard, compact, and brownish gray. The plates are about one-eighth of an inch thick and break easily into fragments about one-fourth to one-half of an inch on a side. When moist the till is grayish yellow or olive gray, rather soft, and plastic. When dry the fragments are very hard and when crushed the mass is

grayish yellow or yellow. Roots and moisture penetrate the surface soil and the subsoil readily, but the compact till is practically impervious. The entire soil is very strongly acid, as the pH value ranges from 4.5 to 5.0.

The soil and the glacial till are distinctly gritty and sharp in most places, but in some places they have a smooth clayey texture. In many places the very hard till lies directly beneath the subsoil, and in a few places the lower part of the subsoil is mottled with gray and rusty brown. Included with this soil are several areas in the vicinity of Jaffrey and Rindge where the gray surface soil in timbered areas is very thin and the subsoil is brownish yellow In Massachusetts, soil similar to this inclusion was classified in the Paxton series. The total area of Paxtonlike soil is so small that it is included wth the Marlow soils.

A total area of 20.3 square miles of Marlow loam is mapped. It occurs only in the eastern half of Cheshire County, in association with the Brookfield, Gloucester, and Hermon soils.

In most places this soil occurs on gently rounded hills where the slope is 12 to 15 percent, but a slope as steep as 20 percent is not uncommon. It was first recognized on long oval hills known as drumlins, but it also occurs on hillsides where the ice sheet probably exerted great pressure The parent material is made up of both schist and granitic rocks, but most of the stones on the surface and in the soil are granite or gneiss, although there are a few reddish-brown weathered micaceous schist rocks, some of which may contain iron pyrites. This soil occurs only in localities where the reddish-brown schist outcrops.

Surface drainage, or runoff, is rapid, and the surface soil and subsoil layers are well drained and aerated, except in the spring. The substrata are practically impervious, so that excess subsoil water moves slowly downhill parallel to the surface. This soil warms very slowly in the spring; roads built on it are sometimes soft and almost impassable until the middle of May.

Practically all of the land is cultivated, but a small part of it is in pasture and a few areas are timbered. It is the most desirable soil in the districts where it occurs and many successful dairy farms are situated on it. It is managed in much the same manner as Charlton loam, and the yields on the two soils are about equal. Corn for silage yields from 10 to 14 tons an acre; oats 35 to 40 bushels or 1½ to 2 tons of hay if cut green; hay about 1 to 3 tons, depending on the age of the meadow; and potatoes about 200 to 350 bushels. Manure is applied to sod before it is plowed for corn, and in addition from 300 to 500 pounds of superphosphate or 4–12–4 fertilizer is applied when the corn is planted. Potato fields are heavily fertilized; many farmers use 1,000 pounds of 8–16–16 or 8–16–14, especially if they are growing a rather large crop for sale. Hay meadows are allowed to stand for 10 years or more on some farms, but most farmers plow them after 3 or 4 years or when the yield falls below 1 ton an acre. Many hayfields are top-dressed with manure in the fall or during the winter. Pastures receive little care; but Kentucky bluegrass, locally known as junegrass, and sweet vernalgrass come in naturally. Many fields have been almost overrun by moss, hardhack, and juniper. From 2 to 4 acres, depending on the presence of weeds or other pests, are required for each cow. Where the soil is

forested the most common trees are beech, red oak, sugar maple, white and gray birch, and white pine.

Grasses and other crops have sufficient water for steady growth in most seasons, but they may wilt during long dry periods.

Marlow stony loam.—This soil is similar to Marlow loam in all respects except that there are so many stones on the surface and in the soil that they hinder or actually preclude cultivation.

In addition to the variations and inclusions made with Marlow loam, a few areas are included with this soil where outcrops are numerous and where bedrock lies from 1 to 6 feet beneath the surface.

Marlow stony loam is associated with Marlow loam and has a total area of 41.6 square miles. This soil occurs only in Cheshire County. Some areas near farms are used as pasture, but the isolated areas are forested. About 60 or 75 percent of the area is in forest. Beech, red oak, sugar maple, white, yellow, and gray birch, white pine, and some spruce, fir, and hemlock are the most common trees.

Moss, hardhack, blueberries, and juniper are abundant in many pastures, and in some they have almost crowded out the grasses. From 2 to 4 acres of pasture is required for each cow.

Marlow stony loam, steep phase.—This soil is similar to typical Marlow stony loam except that the slope is greater than 20 percent. The average slope is only a little more than 20 percent, and very few areas have a slope steeper than 25 percent.

Associated with the other Marlow soils, this soil covers a total area of 10.7 square miles in Cheshire County.

A large proportion of this land is in timber, as it erodes rapidly if pastured heavily during wet periods.

Blandford loam.—The surface soil of Blandford loam to a depth of about 4 inches in timbered areas and to a depth of 6 of 7 inches in cultivated fields and pastures is dark grayish-brown heavy loam that forms soft crumblike aggregates. The subsoil is yellowish- or olive-brown loam that breaks into soft granules. At a depth of 12 to 15 inches it rests on the substratum of gray, greenish-gray, or olive-gray compact platy silt loam glacial till. This material is friable, although it is practically impervious to water and roots. The surface soil and subsoil layers are very strongly acid, and the substratum is slightly acid. In most places very few stones are on the surface and the walls are low, but small fragments of slaty schist are numerous in the soil and substratum. Many of the larger stones are bluish-gray slaty schist, and there are a few granitic rocks.

In some places a thin layer, 3 or 4 inches thick, of mottled gray, rusty-brown, and yellowish-brown soil lies between the subsoil and the substratum. Included with this soil are a few areas in which the stones have not been picked off the surface and some areas in which bedrock lies within 3 feet of the surface. These inclusions would be mapped as Blandford stony loam and Blandford loam, shallow phase, respectively, if they were extensive enough to warrant the separation.

About 7.3 square miles of this soil is mapped, mainly in Sullivan County in the vicinity of Claremont and Unity, and a few small areas are near Alstead Center in Cheshire County.

Blandford loam has developed on high ridges from very fine-grained till derived largely from slaty schist. The relief is gently undulating, as the average slope is about 5 percent and the maximum

slope about 12 percent. Internal drainage is slow; nevertheless the slope is sufficient to provide adequate runoff of surface water.

Very little of the soil is cultivated. About 40 percent of the land is in old mowings, and about 50 percent is in pasture. A few small areas are cultivated, and a few are in wood lots. High yields of potatoes, 200 to 300 bushels an acre, are obtained when the soil is fertilized heavily, and fair oat yields, about 30 to 35 bushels, are reported. Corn, however, does not always mature. Hay yields from 1 to 3 tons an acre, depending on the age of the seeding. Timothy and redtop are the principal grasses in new seedings, but poverty oatgrass, sheep sorrel, devils-paintbrush, and hardhack come in on the old meadows. Pastures seldom fail for lack of moisture, but some have been taken over by aspen sprouts, moss, and white pine. An area of 2 to 4 acres is required to pasture each cow. Some of this soil can be plowed in the fall, as danger of erosion is slight on the moderate slopes.

Sutton silt loam.—To a depth of 7 or 9 inches, the surface soil of Sutton silt loam is dark-brown or dark grayish-brown friable silt loam or heavy loam having a soft-crumb structure. The subsoil, which reaches to a depth of 13 or 15 inches, is yellowish- or grayish-brown friable silt loam having a soft- to firm-crumb structure. Beneath this and continuing to a depth of 16 to 24 inches is a layer of mottled soil. In most places this material is highly mottled olive-gray, grayish-yellow, grayish-brown, and dark rusty-brown loam; but in some places it is grayish-yellow loam mottled or streaked with gray and rust brown. The glacial till substratum is olive-gray compact platy friable smooth till that is mottled with brown and is slightly plastic when moist. The reaction is medium to strongly acid.

In some places the surface soil and the subsoil are slightly mottled with gray and rust brown, and in a few places the surface soil and the subsoil are loam.

Sutton silt loam is associated with the Charlton soils. It occupies imperfectly drained slight depressions and nearly flat areas at the foot of slopes. Most of the bodies are small. This soil covers a total area of 4.8 square miles. It has developed from glacial till derived mainly from schist rocks.

Most of this soil is used as pasture or mowing, although some corn and oats are grown. The soil warms late in the spring, and crops may drown or lodge during wet seasons. Corn cut for silage yields 11 to 15 tons an acre and oats 35 bushels of grain or 1½ to 2 tons of hay in favorable seasons. Hay yields are high, 2 or 3 tons in good mowings, and fields are not plowed until the yield drops below 1 or 1½ tons an acre. Sometimes fertilizer is applied at the time of planting corn, and manure is applied to the meadows every 1 or 2 years. If kept free of moss, hardhack, and other pasture pests, 2 acres will furnish sufficient pasture for a cow. Some fields, however, are almost completely covered by weeds; hence they are almost useless for pasture. Bluegrass (junegrass) and bentgrass are the most common pasture constituents. Fields on this soil are so soft in the spring that some cannot be pastured until late in May.

A total area of about 2 square miles of Sutton silt loam is sufficiently stony to hinder or preclude cultivation with machinery. The stony areas are associated with typical Sutton silt loam and with

the Charlton soils. Much of this stony soil is used as pasture, but some is in timber. An area of 2 to 4 acres, depending on the presence of pasture pests and stones, is required to pasture each cow. Where the land is forested, the most common trees are red maple, sugar maple, red oak, beech, yellow birch, and elm.

Essex loam.—In cultivated fields the 6- or 7-inch surface soil is dark-brown friable loam having no apparent or very soft crumb structure. In forested areas a 2- or 3-inch layer of dark-brown or nearly black fluffy organic matter lies on the surface. In some places the mineral surface layer is black greasy mucky loam to a depth of about half an inch, and below this to a depth of about 2 inches the subsurface soil is light-gray or nearly white fine sandy loam or sandy loam that shows very weak development of a platy structure. In many places this gray layer is very thin, half an inch or less thick, and the surface soil, to a depth of about 2 inches, is dark grayish-brown loam. Beneath this and extending to a depth of 6 or 7 inches the subsoil is strong-brown or coffee-brown smooth friable loam with no apparent structure. The lower part of the subsoil, or in cultivated fields the upper part, extends to a depth of about 12 to 15 inches and is yellowish-brown or ocher-colored friable loam having no apparent structure. Beneath this and extending to a depth of about 20 to 24 inches the subsoil is yellow or grayish-yellow loam. This material has a soft platy structure that has probably been inherited from the glacial till substratum. In most places there is a layer of gray fine sandy loam friable but platy or compact soft till that extends to a depth of 26 to 30 inches, but in some places the gray hard platy sandy loam till lies at a depth of 24 inches. This till is very compact and difficult to remove from a cut or to penetrate with sampling tools, but when removed it falls apart into hard fragments. Water can move slowly around these particles. Most of the particles are coated with grayish brown, and they are gray when crushed. In a few places the lower part of the subsoil is mottled gray, grayish brown, and rust brown. The surface soil and subsoil layers are very strongly acid (pH 4.5 to 5.0), and the substratum is strongly acid (pH 5.5).

Included with this soil are some areas having surface soil and subsoil layers of fine sandy loam. The Essex soils grade into the Charlton and Marlow soils and to a less extent into the Gloucester and Hermon soils. In some areas they resemble those soils.

Essex loam is mapped in the eastern half of the area, especially in the vicinity of Newport. It is associated with the Gloucester soils and in places with the Peru soil (pl. 2, *A*) and the Hermon soils (pl. 2, *B*). The total area is 15.1 square miles.

The land is undulating. The average slope is 10 or 12 percent, but on some areas it is 20 percent. In most places this soil occupies hilltops or slopes that face north or west. It has developed from glacial till composed largely of gneiss and other granitic rocks, and in some places there are a few schist boulders. The compactness of the till may be due to the weight of the glacier.

Surface drainage is rapid, and runoff must be controlled in cultivated areas. Water percolates readily through the surface soil and the subsoil but very slowly through the substratum. As the soil retains moisture well, plants are seldom injured during dry periods.

This soil warms late in the spring, and earth roads on it may be impassable during April and the early part of May.

Most areas of Essex loam lying near passable roads are cultivated, but some areas have been abandoned and are now or soon will be in forest. Many successful dairy farms are situated on this soil, and in these places the land is farmed in the same manner as Charlton loam and Marlow loam. Corn is grown for silage, yielding about 12 tons an acre. Oats are usually cut green and yield from 1½ to 2 tons an acre, or 30 to 35 bushels of grain if threshed. Hay yields from 1 to 2 tons an acre, depending on the age of the seeding and the presence of weeds. In new seedings timothy and redtop are the most common grasses, but quackgrass or witchgrass, poverty oatgrass, sheep sorrel, cinquefoil, and daisies invade old mowings. Heavy applications of manure are made to the sod before plowing for corn and as a top dressing on some mowings. In addition to manure, from 300 to 500 pounds of superphosphate or 4–12–4 fertilizer is applied by most farmers when planting corn. A large acreage of Essex loam is used for growing potatoes. In recent years many fields that had been abandoned or used as pasture have been plowed and planted to potatoes. On these fields no manure is used and no rotation is followed, but potatoes are planted year after year. From 1,000 to 1,200 pounds of 8–16–16 or 8–16–14 is applied each year for potatoes, and yields as high as 300 or more bushels to the acre are reported. Kentucky bluegrass, bentgrass, and sweet vernalgrass are the common pasture grasses in better fields, but many pastures contain much moss, poverty oatgrass, and hardhack, and many small trees. From 2 to 4 acres of pasture is required for each cow, depending on the degree of infestation by weeds and other pasture pests.

Where row crops are grown year after year, erosion becomes severe, and some method for the control of runoff must be practiced if the soil is to be conserved.

Where the soil is forested, the most common trees are sugar maple, white and gray birch, spruce, hemlock, and white pine.

Essex stony loam.—This soil is similar to Essex loam in all respects except that stones are numerous enough on the surface to hinder or prevent cultivation. This soil is associated with Essex loam, and the total area is 33.7 square miles.

Some of this soil is used as pasture, but most of it is forested and some abandoned areas are used to pasture sheep and young animals of other livestock. From 2 to 4 acres of pasture is required for each cow, depending on the quantity of stones, moss, hardhack, and trees present.

Essex stony loam, steep phase.—This soil is similar to Essex stony loam except that the slope is greater than 20 percent, averaging about 25 percent. Included with this soil in mapping are a few areas that have a slope of a little more than 20 percent but from which the stones have been removed.

This soil occurs in association with other Essex soils. It has a total area of 19.1 square miles.

Most of the land is forested, but some is used as pasture. An area of 3 to 4 acres, depending on the presence of weeds or other pests, is required to pasture each cow, but care must be taken during wet seasons, as erosion is severe if the land is too heavily pastured.

Peru stony loam.—The 3- to 5-inch surface soil of Peru stony loam is dark-brown or dark grayish-brown friable loam, and the upper part of the subsoil is brown or grayish-brown friable loam that in some places is faintly mottled with rust brown and gray. This material reaches to a depth of 12 to 15 inches. The material in both these layers has a soft-crumb structure. Below this and continuing to a depth of about 20 inches the subsoil is mottled gray, grayish-yellow, grayish-brown, and dark rusty-brown gritty loam or fine sandy loam having a soft platy structure. The substratum is gray or grayish-yellow very compact and platy gritty till mottled with rust brown. All layers are very strongly acid in reaction, having a pH value of about 4.8.

Peru stony loam is an imperfectly drained soil of the plateau section of the area associated with the Essex (pl. 2, *A*), Gloucester, Marlow, Brookfield, Hermon, Canaan, and, in some places, Charlton soils. It is widely distributed, but most of the areas are small. This soil is most common in the districts where the Essex soils occur and has a total area of 16.9 square miles.

Included with this soil are areas of several variations: (1) Associated with the Charlton and Marlow soils, the surface soil and subsoil layers are smooth loam or silt loam and the substrata consist of fine-grained material derived from schist; (2) associated with the Hermon soils, the surface and subsoil layers are gritty loam and the substrata are sandy and slightly compact; and (3) associated with the Brookfield soils, the substrata are grayish yellow and very micaceous. In some places stones are so numerous on the surface and in the soil that they constitute 30 to 40 percent of the total mass. In a few places, as at Ryder Corner in the southeastern part of Croydon, the stones have been removed from the surface and the soil included in cultivated fields. Included with this soil in mapping are a few areas in the vicinity of Richmond that have very dark mucky surface soils to a depth of about 6 inches, and the subsurface layers, which extend to a depth of 12 to 15 inches, are gray and in some places faintly mottled with brown. The subsoil, to a depth of about 20 inches, is dark-brown or coffee-colored loam.

Peru stony loam occurs on nearly flat, rather broad hilltops, in slight depressions, and on benchlike formations that receive seepage water from higher areas.

Very little of this land is cultivated, but a small proportion is in hay meadows. It cannot be cultivated successfully unless artificially drained. It is used as pasture if situated near a farm, but much of it is in wood lots. Most of the pastures contain much hardhack, ferns, and meadowsweet and some alder, all of which reduce the grazing area. The pasture consists mainly of creeping bentgrass and some sedges in the wetter parts. From 2 to 4 acres of this land is necessary to furnish grazing for one cow. In forested areas the most common trees are spruce, hemlock, sugar maple, red maple, white birch, gray birch, beech, and white pine.

Whitman stony loam.—The 6- or 8-inch surface soil of Whitman stony loam is very dark-gray loam or mucky loam that has a soft fine granular structure. The subsoil is dark-gray friable loam or sandy loam. This rests at a depth of 10 to 12 inches on the substratum of gray loam or sandy loam, which is mottled with rust

brown and has some soft rust-brown concretions. Many stones are on the surface and throughout the soil. In some places boulders represent as much as 50 percent of the surface area.

This soil occupies poorly drained situations in association with the soils of the uplands. Where associated with the soils developed from schist the soil material is smooth, but where associated with soils developed from granitic material it is gritty and in places is sandy loam. In some places the subsoil is very compact and platy; in others it is comparatively loose. Included with this soil are several areas at the heads of small draws that have sandy deposits on the surface because they receive considerable wash from surrounding areas.

As mapped, Whitman stony loam includes many small nonstony areas, totaling about 3 square miles. The nonstony soil is generally in mowings or in pastures, as it represents poorly drained spots that have been cleared in order to improve the shape of a field. If drained, the soil is suitable for the production of corn, but oats tend to lodge on it. The most common use of the nonstony soil is as pasture land; and, if kept free of willow, alder, and sedges, it furnishes good grazing in dry weather, although it may be very soft or even flooded during wet seasons.

Whitman stony loam is widely distributed over the area, and most of the individual bodies are small. The total area is 21 square miles.

Most of this soil is forested or in brush, but a few areas have been cleared and included in pastures. In forested areas the most common trees are gray and yellow birch, red maple, hemlock, and some white pine. Small willows, alders, and sprouts of the various hardwoods grow in many areas, particularly those that were once included in pastures. Very little grazing is afforded by most of the stony areas.

SOILS OVER FIRM COARSE-TEXTURED GLACIAL TILL

The combined area of soils over firm coarse-textured glacial till is about one-half as large as the area of the soils over compact fine-textured till. These soils predominate in the central and eastern parts of the two counties, except in districts occupied by areas of the Marlow and Essex soils and areas of rough stony land, which will be discussed later. This group includes types and phases of the Gloucester, Shapleigh, Hermon, Canaan, and Brookfield series.

The Gloucester soils have brown surface soils, yellowish-brown or brownish-yellow subsoils, and gray gritty firm but friable glacial till substrata derived from granite and gneiss. Gloucester fine sandy loam and Gloucester stony fine sandy loam and its steep phase are mapped.

The Shapleigh soils resemble the Gloucester soils in surface soil and subsoil characteristics, but bedrock lies at comparatively slight depths. The microrelief of the bedrock is not parallel to the surface of the soil, and the thickness of the soil mantle ranges from a few inches to several feet but averages less than 3 feet. They also are much like the Canaan soils, except that the gray layer just beneath the surface or organic mat in wooded areas is either lacking or is very thin. In old pastures this layer is lacking entirely.

Shapleigh sandy loam, Shapleigh stony sandy loam, and Shapleigh stony sandy loam, steep phase, are shown on the map.

Like the Gloucester soils, the Hermon soils are developed on gray gritty firm but friable glacial till derived from granite and gneiss, but in most places they occur at higher altitudes than the Gloucester soils. In cultivated and recently abandoned areas these two soils resemble each other. In old forests, however, the Hermon soils are distinguished by a layer, about 4 inches thick, of organic matter overlying a layer, 2 inches or more thick, of nearly white mineral soil, a dark-brown or coffee-colored upper subsoil layer, and a yellowish-brown or brownish-yellow lower subsoil layer. Hermon stony sandy loam and its steep phase are mapped.

The Canaan soils resemble the Hermon soils throughout the surface soil and subsoil, but the substratum of bedrock lies within a few inches to 4 feet of the surface. Canaan stony sandy loam is mapped.

The Brookfield soils have developed where the glacial till includes a large quantity of brownish-red micaceous schist, in some places containing pyrites. In forested areas, a 2- or 3-inch layer of organic matter overlies a ½- to 1-inch layer of mineral soil that is nearly white or very pale purplish gray. The subsoil and substratum are yellowish brown and contain many small flakes of black mica. Brookfield loam and Brookfield stony loam, with its steep and shallow phases, are mapped.

A large part of the area of these soils, especially of the Gloucester and Hermon soils, once was cultivated, but most farms situated entirely on them have been abandoned. Most of the remaining farms depend partly on income from enterprises other than farming. Much of the land in farms is used as pasture or wood lots on farms where the cropland consists of finer textured soils. Nevertheless, these soils can be farmed profitably when there is a greater demand for agricultural products, as they are less likely to erode and they warm earlier in the spring than the finer textured soils. Potatoes and milk are produced economically on some favorably situated farms. Large quantities of manure and some fertilizer are used on farms where high yields are obtained. Corn, oats, hay, and potatoes are the principal crops grown. From 20 to 25 loads of manure (in a 38-bushel spreader) is applied to the sod before plowing for corn, and 300 to 500 pounds of 4–12–4 mixed fertilizer or superphosphate is applied when corn is seeded. Many farmers also apply fertilizer when seeding oats, and some hayfields are top-dressed with manure.

Gloucester fine sandy loam.—This soil occurs at low and moderate elevations in the central and eastern parts of the two counties, most commonly on southern slopes, where, in places, it reaches an elevation as high as 1,500 feet above sea level. On some northern slopes, however, the Hermon soils, which generally lie above the Gloucester, occur at an elevation as low as 1,200 feet. The total area is 16 square miles. The relief is gently rolling. The slope averages between 12 and 15 percent and reaches a maximum of about 20 percent. Internal drainage is good to excessive. Although runoff is rapid during heavy rains, it is slight during normal rains, as the soil is very porous. During periods of dry weather, plants are injured by lack of moisture.

In forested areas a layer, from 1 to 3 inches thick, of very dark brown partly decayed leaves and twigs covers the surface. The min-

eral surface soil to a depth of half an inch, or in some places as much as 2 inches, is very light gray or nearly white fine sandy loam. The upper part of the subsoil, reaching to a depth of about 6 inches, is dark-brown loose fine sandy loam. In cultivated fields these horizons have been mixed by plowing to form a brown mellow fine sandy loam without well-defined structure, about 6 inches thick. The subsoil is strong-brown friable fine sandy loam of massive consistence. This rests at a depth of about 8 to 10 inches on light-brown mellow fine sandy loam, which continues to a depth of 12 to 15 inches. Beneath this, yellowish-brown mellow fine sandy loam of massive consistence or grayish-yellow loamy fine sand extends to a depth of 24 to 30 inches. The substratum is gray or yellowish-gray firm gritty glacial till. In most places about 30 percent of the material consists of stone fragments more than 4 inches in diameter. Even though the soil is fairly firm throughout, the material falls into an amorphous mass when slight pressure is applied. The reaction in most places is very strongly acid to strongly acid as the pH value is about 5.0 or slightly higher.

The thickness and the depth of color of the several layers, especially of the substratum, vary slightly in many places. In a few places, as in the western part of Richmond and in the vicinity of Swanzey Lake, the substratum is bluish gray or salt-and-pepper colored. In some places, such as east of Monadnock Mountain and in other places where small quantities of reddish-brown rocks have been mixed with the granitic debris, it is grayish yellow. In most places the substratum is firm in place and is very slightly compact or cemented; but in some places, as near Fitzwilliam, it is very loose, coarse, and nearly white. The color, texture, and structure of the material from which the soil is developed depend on the mineral composition of the rocks included in the glacial till. In most places the glacial till is of local origin and lies on rocks similar to those from which it was formed. Included with this soil are many areas in which the texture of the surface soil and subsoil layers is sandy loam. In the southern part of Chesterfield a few areas are mapped in which the parent glacial till is derived from gray siliceous or sandy schist. Here, the surface soil and subsoil layers are similar to those of the typical soil, except that they may have more fine material. The substratum is very loose and gritty but contains many small fragments of sandy schist. These areas are slightly more productive than areas of the typical soil.

A large proportion of this soil is in mowings, many areas are used as pasture, some are cultivated, and a few are forested. Most of the areas in mowings are on farms that are otherwise abandoned. The fields are small and surrounded by stone fences. There were no nonstony areas of Gloucester soil when the land was first cleared. Some corn, oats, and potatoes are grown, but most farms situated on Gloucester soil are marginal for agriculture, and many are maintained only as summer homes. On the many cropped areas manure is about the only amendment added, except that small quantities of mixed fertilizers are added when corn is planted and large quantities when potatoes are grown. On the better farms manure is spread on the sod before plowing for corn, and about 300 to 500 pounds of superphosphate or 4–12–4 mixed fertilizer is applied when corn is planted. The yield is about 25 to 35 bushels of grain or 6 to 8 tons of silage to

the acre. Timothy and redtop are commonly grown for hay, and in new seedings the yield is 1½ tons an acre. Many mowings are 10 or more years old, and these yield only one-half to three-fourths of a ton of poor-quality hay to the acre. The yields given above apply only on the better managed farms or where the soil is slightly above average in quality. In many places the yields are about half as much, and during dry seasons crops may fail. A few potatoes are grown for market, and the land receives about 1,000 to 1,200 pounds of 8–16–16 mixed fertilizer to the acre for this crop. The average yield is about 150 to 200 bushels an acre. The common pasture grasses are bentgrass, poverty oatgrass, and witchgrass. Hardhack, ferns, mosses, juniper, aspen (locally called popple) sprouts, and other brush are common in most pastures, and from 3 to 6 acres of pasture is required for each cow. The common trees in forested areas are white pine, white birch, gray birch, red oak, and sugar maple.

This soil is not plowed in the fall, as severe erosion would result during spring rains when the subsoil is still frozen. It is, however, the first soil in this group of the rolling and hilly uplands to become warm and tractable in the spring.

Gloucester stony fine sandy loam.—This soil is similar to Gloucester fine sandy loam except that there are sufficient stones on the surface to hinder seriously or actually to preclude cultivation. It is associated with Gloucester fine sandy loam. The total area is 98.3 square miles.

Most of this soil is forested, but many areas are used as pastures. The common trees are red oak, hard maple, aspen, gray birch, yellow birch, beech, and white pine. The common pasture grasses are bentgrass, poverty oatgrass, Kentucky bluegrass, and witchgrass. Hardhack, juniper, moss, ferns, and aspen and pine sprouts are present in most pastures, and from 3 to 6 acres of pasture is required for each cow.

Gloucester stony fine sandy loam, steep phase.—This soil is similar to typical Gloucester stony fine sandy loam, but it is situated on slopes greater than 20 percent. The average slope is about 25 percent, and the maximum slope is more than 40 percent. This soil is associated with the other Gloucester soils. It has a total area of 15.8 square miles.

Practically all of this soil is forested, but some areas are used as pasture. In forested areas the common trees are red oak, sugar maple, aspen, gray birch, yellow birch, beech, and white pine. The common pasture grasses are bentgrass, poverty oatgrass, witchgrass, and Kentucky bluegrass. Hardhack, moss, ferns, juniper, and aspen sprouts and other brush reduce the grazing afforded in most pastures, so that from 3 to 6 acres of pasture is required for each cow.

As mapped, Gloucester stony fine sandy loam, steep phase, includes several small steeply sloping areas of a nonstony soil. Most of this inclusion is used for pasture, and a small part is forested.

Shapleigh sandy loam.—This soil is developed where a thin mantle of glacial till rests on granite and gneiss bedrock in rolling to mountainous areas.

The surface soil and the subsoil of Shapleigh sandy loam are similar, except in texture, to the corresponding layers of Gloucester fine sandy loam. As the relief of the bedrock is very irregular and does not

parallel the surface of the ground, a heterogeneous mixture of soils results. One small area of typical soil containing many rock outcrops may be only a few feet away from one in which the layer of glacial till between the soil and the underlying rock is 3 feet or more thick. In most places this deeper soil material covers about half the total area.

Included with this soil are small areas of a thin deposit of platy till, similar to that from which Essex soils have developed, that overlies the rock. In these places a shallow soil having the characteristics of Essex loam occurs.

Shapleigh sandy loam is associated with Gloucester and other Shapleigh soils. The total area is about 2.5 square miles, most of which is in Sullivan County. The land is gently rolling, the average slope is about 15 percent, and the maximum slope 20 percent.

Water percolates easily through the porous soil but runs along the top of the bedrock or through fissures in it. In some places the bedrock holds water in pools and gives up moisture to plants during dry periods; in other places water leaves the soil and plants are injured by lack of moisture in dry periods. During very heavy rains water runs off the soil so that severe erosion may result, but most water falling on this soil during a normal rain is absorbed.

Practically all of this soil is used as pasture, but some areas with few outcrops and a large fraction with the thicker soil mantle are cultivated or in mowings. The common pasture grasses are bentgrass, poverty oatgrass, and witchgrass. Hardhack, ferns, moss, juniper, aspen sprouts, and other brush are common pests in most pastures. From 3 to 6 acres is required to furnish grazing for each cow for an entire season. Most of the cultivated areas are vegetable gardens or small parts of larger fields. Definite data regarding crop yields and management practices are not available. Yields are uncertain and are greatly influenced by moisture supplies.

Shapleigh stony sandy loam.—This soil is similar to Shapleigh sandy loam except that it has never been cleared of stone. In most places, however, more than 50 percent of the area of the soil has a normal profile, and bedrock lies 4 feet or more below the surface. About 20 square miles are mapped, mainly in association with other Shapleigh soils and with the Gloucester soils.

In a few areas north of Winchester the bedrock is very soft partly disintegrated granite. There are no outcrops in these areas, and in some places this soft granite is excavated and used as road material. Also included with this soil in mapping are small areas where there is a shallow deposit of platy till similar to that on which the Essex soils are developed. In these places the surface soil and subsoil layers have a loam texture.

Practically all of the land is forested, but a few areas are pastured. The common trees are red oak, sugar maple, gray birch, yellow birch, aspen, beech, and white pine. The common pasture grasses are bentgrass, poverty oatgrass, witchgrass, and some Kentucky bluegrass. Hardhack, moss, juniper, ferns, aspen sprouts, and other brush reduce the grazing capacity of most pastures, so that from 3 to 7 acres of pasture is required for each cow.

Shapleigh stony sandy loam, steep phase.—This phase, as its name indicates, has a steeper slope than Shapleigh stony sandy loam. It occurs only in Sullivan County. This soil is best suited to for-

estry and is used almost entirely for this purpose. It covers a total area of 0.2 square mile.

Hermon stony sandy loam.—This soil is mapped at high altitudes, in most places more than 1,500 feet above sea level, in the extreme northeastern and eastern parts of Sullivan County and in the vicinity of Monadnock Mountain in Cheshire County. The relief is gently rolling, having an average slope of about 15 percent and a maximum slope of 20 percent. The total area is only 1 square mile.

In pastures this soil resembles the Gloucester soils, but in forested areas a 2- to 4-inch layer of very dark-brown partly decomposed organic matter overlies a 2- or 3-inch layer of mineral soil, which is light-gray or nearly white mellow loamy sand of no definite structure. To a depth of 4 to 6 inches the subsoil is dark-brown or coffee-colored friable stony sandy loam. In pastures these layers are mixed to form a dark-brown or grayish-brown friable sandy loam surface soil. Beneath this and extending to a depth of 15 to 20 inches, the subsoil is yellowish-brown or brownish-yellow mellow stony sandy loam or loamy sand. The lower subsoil layer, reaching to a depth of about 30 inches, is grayish-yellow firm loamy sand. The substratum is gray gritty firm glacial till made up of granitic rock debris and containing from 20 to 50 percent of stone fragments more than 4 inches in diameter. Even though all layers have a massive consistence and are firm in place, when slight pressure is applied the material falls into an amorphous mass. In most places the reaction is very strongly acid throughout, but in some places the substratum has a medium-acid reaction.

Hermon stony sandy loam is well drained, as water percolates readily through the porous soil and substratum. During very hard rains some water runs off, but the soil absorbs most of the rain that falls on it. During very dry periods plants are injured by lack of moisture, as the soil and substratum become very dry.

Many large stone and boulders are on the surface and in the soil. Some areas are used as pasture, but many are forested.

A few small areas of Hermon sandy loam, without stone in the plow layer, are included on the map with Hermon stony sandy loam.

The common pasture grasses are bentgrass, poverty oatgrass, and witchgrass. Hardhack, ferns, mosses, juniper, aspen sprouts, and other brush are common in most pastures, and from 3 to 6 acres of pasture is required for each cow. The common trees in forested areas are white pine, white birch, gray birch, red oak, sugar maple, spruce, hemlock, and balsam fir.

Hermon stony sandy loam, steep phase.—This soil is similar to typical Hermon stony sandy loam, except that it has a slope greater than 20 percent (pl. 2, *C*). The slope averages 25 percent or more, and in many places it is 40 percent. A total area of 2.2 square miles of this soil is mapped in Sullivan County mainly in association with Hermon stony sandy loam.

Practically all of the land is forested, but some areas are used as pasture. White pine, sugar maple, white birch, gray birch, spruce, hemlock, and balsam fir are the most common trees. Bentgrass, poverty oatgrass, and witchgrass, together with the plant pests—hardhack, ferns, mosses, juniper, aspen sprouts, and other brush—grow

in most pastures. From 4 to 7 acres of pasture is necessary to maintain each cow.

Canaan stony sandy loam.—The surface soil and the subsoil of Canaan stony sandy loam are similar to the corresponding layers of Hermon stony sandy loam, but the substratum is bedrock instead of glacial till. As the relief of the bedrock is very irregular and does not parallel the surface of the ground, a heterogeneous mixture of soils results. One area of typical Canaan stony sandy loam containing many rock outcrops may be only a few feet away from one in which the layer of glacial till between the soil and the underlying rock is 3 feet or more thick. Stones are numerous enough on the surface of Canaan stony sandy loam to hinder seriously if not actually to preclude cultivation with machinery. In most places the deeper soil material covers about one-half of the total area.

The land is gently rolling; the average slope is about 15 percent, and the maximum slope is 20 percent.

Water percolates readily through the porous soil but runs along the top of the bedrock or through fissures in it. In some places the bedrock holds the water in pools and gives up the soil moisture to plants during dry periods; in other places the water leaves the soil, and plants are injured by lack of moisture during dry periods. During very heavy rains water runs off the soil, so that severe erosion may result; but most of the water falling on this soil during a normal rain is absorbed.

This soil occurs in association with the Hermon soils and covers a total area of only 0.9 square mile in Sullivan County.

Practically all of the land is forested, but a few small areas are used as pasture. The most common trees in forested areas are white pine, sugar maple, white birch, gray birch, spruce, hemlock, balsam fir, and red maple. The most common pasture grasses are bentgrass, poverty oatgrass, and witchgrass. Hardhack, ferns, moss, juniper, aspen sprouts, and other brush have invaded most pastures. From 3 to 7 acres of pasture is necessary to furnish grazing for each cow.

Brookfield loam.—In forested areas a 1- to 3-inch layer of dark-brown partly decomposed organic matter is underlain by a 1- or 2-inch layer of mineral soil consisting of light-gray or nearly white mellow loam or fine sandy loam that in many places is faintly tinted with purple. This layer has a soft platy structure and in most places contains many small flakes of white mica. The upper ½ or 1 inch of the subsoil is dark-brown loam, which grades into yellowish-brown friable micaceous loam. This material extends to a depth of 5 to 7 inches. These layers have a massive consistence. In cultivated fields they are mixed to form a brown loam surface soil having a soft-crumb structure. The subsoil, which reaches to a depth of 30 to 35 inches, is brownish- or ocherous-yellow friable micaceous loam or fine sandy loam with massive consistence. The substratum is brownish-yellow micaceous glacial till of massive consistence. This glacial till is derived largely from reddish-brown quartz mica schist that in some places contains iron pyrites. In some places there is sufficient mica to impart a greasy feel to the material, but in most places the material is loose and sandy. In a few places it is very loose and resembles kame deposits. Stone fragments, numerous in the soil and substratum, in some places represent 40 percent of the material.

Many of the fragments are flat pieces of reddish-brown schist, but some are granitic, and in a few places the rock is reddish-brown fine-grained micaceous massive gneisslike rock. In some places the glacial till substratum is used for road building, but roads built from it are very dusty when dry and slippery when wet. The soil material in all layers is extremely acid to very strongly acid in reaction, although in a few places the pH value of the substratum is as high as 5.5. In most places bedrock lies from 4 to 8 feet below the surface, and there are a few scattered outcrops.

Brookfield loam is associated with the Gloucester, Hermon, Essex, Marlow, and, to a small extent, Charlton soils wherever the reddish-brown rock lies near the surface. This soil is mapped in the southern part of Sullivan County and the central and eastern parts of Cheshire County and has a total area of 3.2 square miles.

The relief is dominantly gently rolling, but in some places it is hummocky. The average slope is about 15 percent, and the maximum slope is 20 percent. Water percolates readily throughout the soil, but it runs off rapidly during hard rains.

Practically all of the land is used as pasture, except a few cultivated and forested areas. Plants wilt during long periods of dry weather, and in most places grazing is poor and crop yields low. Bentgrass, poverty oatgrass, and witchgrass are the common grasses; and hardhack, blueberries, ferns, mosses, aspen sprouts, and other brush have invaded most pastures. From 4 to 8 acres of pasture is required to provide grazing for each cow. Most of the cultivated areas are small, and many of them are in hay. No farm was seen located entirely on this soil. A few areas are used as home gardens. Hay yields from ½ to 1 ton an acre. In forested areas the common trees are white pine, white birch, gray birch, beech, hemlock, spruce, and sugar maple.

This soil should have a cover at all times, as it erodes readily during hard rains and during dry weather wind erosion is fairly severe.

Brookfield stony loam.—This soil is similar to Brookfield loam except that it has sufficient stones on the surface and in the soil to hinder or prevent cultivation with machinery. It is associated with Brookfield loam and has a total area of 17.5 square miles.

Practically all of this soil is forested, but a few areas are used as pasture. In forested areas the common trees are white pine, white and gray birch, beech, sugar maple, spruce, and hemlock. In most pastured areas the common grasses are bentgrass, poverty oatgrass, and witchgrass, which furnish only poor grazing because of the prevalence of hardhack, ferns, blueberries, mosses, aspen sprouts, and other brush. From 4 to 8 acres of pasture is required to graze each cow.

Brookfield stony loam, steep phase.—This soil is similar to Brookfield stony loam, except that the slope ranges from 20 to 40 percent and averages about 25 percent.

Included with this soil as mapped are steep areas from which the stones have been picked and steep areas in which the soil mantle is shallow and outcrops are numerous. This soil is associated with Brookfield loam and covers a total area of 3.4 square miles.

Practically all of the land, except included areas from which the stones have been picked, is forested. The nonstony areas and a few

stony ones are used as pasture. In forested areas the common trees are white pine, white birch, gray birch, sugar maple, beech, hemlock, and spruce. In pastured areas the common grasses are bentgrass, poverty oatgrass, and witchgrass, but hardhack, juniper, ferns, mosses, aspen sprouts, and other brush have invaded most of the pastures. From 4 to 9 acres of pasture is required to maintain each cow.

Brookfield stony loam, shallow phase.—This soil is similar to Brookfield stony loam, except that bedrock lies at a slight depth—in most places not more than 3 feet—and outcrops are numerous. This is more nearly a true shallow soil than any of the other shallow types and phases. Almost everywhere the bedrock is the reddish-brown quartz mica schist underlying most Brookfield soils, but in a few places either granitic or gray schist rock occurs. Many areas of this soil, too small to map separately, lie within areas of the Charlton, Marlow, Essex, Gloucester, and Hermon soils. A few areas of Brookfield loam, shallow phase, are included with Brookfield stony loam, shallow phase, on the soil map.

A total area of 22.9 square miles of this soil is mapped, mainly in association with Brookfield stony loam.

Practically all of the soil, except the included areas from which the stones have been picked, is forested, but a few stony areas and most of the included nonstony areas are used as pasture. A very small part of the nonstony soil is cultivated. White pine, sugar maple, white birch, gray birch, beech, spruce, and hemlock are the principal trees in forested areas. Bentgrass, poverty oatgrass, and witchgrass are the common grasses in pastures, but hardhack, ferns, mosses, blueberries, aspen sprouts, and other brush are prevalent in most pastures, so that an area of 4 to 9 acres is required to furnish grazing for each cow. The few cultivated areas are not extensive, and most of them are used as hay land. Redtop, poverty oatgrass, and witchgrass are the common hay grasses, but there are many weeds in most mowings. The yield is from ½ to 1 ton of low-quality hay. The included nonstony areas are of such minor extent that no data are available regarding crops grown, yields, and agronomic practices.

SOILS OF THE KAMES AND WIND-BLOWN DEPOSITS

All the soils of the kames and wind-blown deposits are coarse-textured, containing a large proportion of either sand or gravel. Although a few areas are included in cultivated fields or mowings, most of the areas are forested or included in permanent pastures.

SOILS OVER GRAVELLY AND SANDY KAME DEPOSITS

The subgroup of soils developed over gravelly and sandy kame deposits comprises closely related and nearly similar soils developed from loose gravelly material that was deposited as hillocks or kames. They are widely distributed over the two counties, but most of the individual areas are small and the combined area is not large. In general they are nonagricultural; most areas are either forested or included in permanent pastures, although a few small areas are included in cultivated fields or mowings. White pine is the most common tree in forested areas. Areas of these soils are valuable in most

pastures, as they warm early in the spring and furnish grazing when areas of other soils are too soft to be pastured. Most pastures receive no attention, however, and hardhack, ferns, mosses, blueberries, juniper, aspen sprouts, white pine seedlings, and other brush are common pests in the fields. The few cultivated areas are small, and data showing general farm practices are not available.

Included in this subgroup are members of Hinckley, Danby, and Jaffrey soil series. The Hinckley soils have thin dark-brown surface soils, yellowish-brown subsoils, and gray or grayish-yellow substrata. In many forested areas a 2- or 3-inch layer of dark-brown partly decayed organic matter lies on the surface, and the mineral surface soil to a depth of 1 or 2 inches is nearly white. The upper 2- or 3-inch layer of the subsoil is very dark brown. Hinckley loamy sand and Hinckley gravelly fine sandy loam are mapped. The Danby soils resemble the Hinckley soils in areas that have been pastured heavily or cultivated, but in forested areas the layer of dark-brown partly decayed organic matter on the surface is from 3 to 5 inches thick and the surface layer of nearly white mineral soil extends to a depth of 2 to 4 inches. The upper part of the subsoil is very dark brown, the lower part is yellowish brown, and the substratum is gray or grayish-yellow loose sand and gravel. Danby loamy sand, Danby gravelly sandy loam, and Danby gravelly fine sandy loam are members of this series.

The Jaffrey soils resemble the Hinckley soils throughout the surface soil, but the substratum is brownish-yellow loose sand and gravel, and there are many black and white mica flakes in all layers. Jaffrey gravelly sandy loam is the only type mapped.

Hinckley loamy sand.—The 8-inch surface soil of Hinckley loamy sand is dark-brown loamy sand or sand. The subsoil is brownish-yellow loamy sand, which grades, at a depth of about 30 inches, into pale-yellow or grayish-yellow sand. This material is stratified in places. Structure has not developed in any layer, and the reaction is medium acid to strongly acid. In some places a few small pieces of gravel, less than half an inch in diameter, are in all layers; and in a few places some large boulders are on the surface and in the soil. The areas containing boulders are shown on the soil map by symbol.

Hinckley loamy sand is mapped in the southern part of both counties and occupies a total area of 1.2 square miles. Where the soil is associated with the Charlton and other soils derived from schist, the substratum has many dark-colored sand grains and is less acid than where the soil is associated with soils derived from granitic materials, as Gloucester soils. In some included areas the soil is very fine sandy loam.

The land is rolling to hummocky, and short slopes as steep as 30 to 40 percent are common. Gravelly substrata provide excessive internal drainage, and only deep-rooted plants or those able to withstand very dry conditions can grow in this soil.

Practically all of this soil is forested or in pasture, but a few small areas are included in cultivated fields. The common trees in forested areas are white pine and aspen. As most of the areas are small, few if any fields are situated entirely on this soil. In most places areas of this soil constitute only a small part of pastures or cultivated fields, so that definite values and agronomic practices

cannot be given. The common grasses in the pastures are poverty oatgrass and broomsedge, which furnish poor grazing during most of the year. Pastures on this soil are useful in the spring, however, when the other soils may be wet and soft. Hardhack, juniper, moss, sorrel, cinquefoil, strawberries, aspen sprouts, and white pine seedlings have invaded most pastures. Crops frequently fail in the cultivated areas, and wind erosion is severe if the soil is left without a cover. Water erosion is not often serious, but during very hard rains deep gullies may form.

Hinckley gravelly fine sandy loam.—In forested areas a 1- or 2-inch layer of dark-brown partly decomposed organic matter lies on the surface of Hinckley gravelly fine sandy loam, and the mineral surface soil to a depth of 3 or 4 inches is dark-brown mellow fine sandy loam with massive consistence. The subsoil, to a depth of 6 or 8 inches, is light-brown mellow fine sandy loam having no definite structure, and below this, to a depth of about 15 inches, it is yellowish-brown firm but friable fine sandy loam. The lower subsoil layer, which extends to a depth of 20 to 25 inches, is brownish- or grayish-yellow loose fine sandy loam. The substrata are composed of loose sand and gravel, which in most places are imperfectly assorted into layers of nearly equal sized materials. Some gravel is on the surface and in all layers—in most places constituting 10 percent or more of the soil mass, but a few bodies are included where the soil is almost free of gravel. In the western part of the area, where this soil is associated with the Charlton and Hollis soils, more than 50 percent and in some places more than 90 percent of the gravel comprises rounded fragments of schist rocks, and in many places remnants of calcareous schist occur at a depth of 6 to 8 feet. Where this soil is associated with soils, such as the Gloucester and Essex, derived from granitic material, the gravel is derived principally from granitic rocks. In many places large boulders are present on the surface and in the soil. In a few places there are veins of very fine sand or silt in this soil, and some areas of Hartland soil, too small to show on a map of this scale, are included with this soil type. Also included are some areas where the texture of the surface soil and subsoil is sandy loam.

This soil has developed on kames at low altitudes in the western and southern parts of the area. It covers 9.9 square miles.

In most places the relief of Hinckley gravelly fine sandy loam is hilly and hummocky, and short slopes as steep as 40 percent are common. In a few places, however, the relief is gently undulating. This soil is well to excessively drained, and plants wilt during dry weather. Very few areas are cultivated. Most of them are included in pastures, and several are forested. In the Connecticut Valley a few of the cultivated areas are planted to alfalfa. Small quantities of lime are added before sowing alfalfa, and the yield is from 1½ to 2 tons an acre. Precise data concerning other yields and agronomic practices are not available, as most of the cultivated areas are included in fields situated principally on some other soil type. In general, yields are low and crops frequently fail. Poverty oatgrass, bentgrass, broomsedge, and witchgrass are common in most pastures but furnish little grazing during the summer. Pastures on this soil are useful early in the spring when other soils are soft. Juniper,

hardhack, cinquefoil, blueberries, ferns, mosses, aspen sprouts, and white pine seedlings are prevalent in most pastures. White pine, red oak, sugar maple, aspen, gray birch, and yellow birch are the common trees in forested areas.

Many areas have pits from which sand and gravel for commercial purposes are excavated.

Danby loamy sand.—In cleared areas Danby loamy sand resembles Hinckley loamy sand, but in forested areas there is a 3- to 5-inch layer or mat of very dark-brown partly decomposed leaves and twigs on the surface. The mineral surface soil to a depth of 2 or 3 inches is light-gray or nearly white loose sand, and the subsoil to a depth of 5 to 7 inches is dark-brown or coffee-colored mellow loamy sand. In cleared areas these layers have been mixed by cultivation or pasturing to form a dark-brown loose loamy sand. The subsoil to a depth of 24 to 30 inches is slightly coherent yellowish-brown loamy sand or sand. The substratum is loose sand or imperfectly stratified sand, coarse sand, and small gravel. The soil in all layers has a single-grain consistence, and in most places the reaction is strongly to very strongly acid.

In many places the dark-brown upper part of the subsoil present in forested areas is slightly indurated. In a few places there are large boulders on the surface and in the soil. These are shown on the soil map with symbols. In some places, such as south of Newport and in the vicinity of the Richmond Trout Rearing Station, small areas of very fine sandy loam and areas having strata of very fine sand and silt are included in mapping. Another inclusion represents very narrow swales, about 50 feet wide, of a poorly drained soil. Except in a few small areas, there is no gravel in any layer. In most places the material was derived entirely from granitic rocks.

Danby loamy sand has developed on rolling to hummocky land (kames) in the northern and western parts of the area, in association with the Marlow and Hermon soils. Short slopes as steep as 40 percent are common. Drainage is excessive, and plants capable of withstanding drought are the only ones that survive. The total area is 13.8 square miles.

Much of this soil is forested, many areas are included in pastures, and a few comprise parts of cultivated fields. In forested areas white pine and aspen are the most common trees. The common pasture grasses are poverty oatgrass, broomsedge, and witchgrass. Hardhack, juniper, cinquefoil, aspen sprouts, and white pine seedlings are common pests in most pastures. Although areas of this soil furnish poor grazing during the summer, they are useful parts of many pastures, as they furnish grazing during the early spring when other soils are soft. As the cultivated areas form only small parts of fields, no data concerning crop yields and agronomic practices are available. In some heavily pastured or cultivated areas wind erosion is severe, and gullies may form in unprotected areas during very hard rains.

Some sand is excavated for commercial purposes.

Danby gravelly sandy loam.—The color profile of Danby gravelly sandy loam resembles that of Danby loamy sand, but the texture is sandy loam, and gravel is present throughout. In forested areas a 3- to 5-inch layer or mat of very dark-brown partly decomposed

organic matter is on the surface, and the mineral surface soil to a depth of 2 or 3 inches is light-gray or nearly white mellow loamy sand. The subsoil to a depth of 5 to 7 inches is dark-brown or coffee-colored firm but friable gravelly sandy loam. In cleared areas the materials in these layers have been mixed by cultivation or pasturing to form brown mellow gravelly sandy loam. The subsoil is slightly coherent yellowish-brown gravelly fine loamy sand to a depth of 24 to 30 inches, and the substratum is imperfectly stratified loose sand and gravel. In most places more than 10 percent of the material in all layers is gravel, but in some places there is very little gravel. The reaction is strongly acid to very strongly acid throughout, although in a few places the substratum is medium acid. The consistence in all layers is single grain to massive, but in some places the dark-brown upper subsoil layer in forested areas is slightly indurated, and in a few places it is very hard when dry. In general, the sand and gravel are derived from granitic rocks. Included with this soil in mapping are 2 or 3 small areas in which the texture of the surface and subsoil is gravelly sandy loam. In the southern and southeastern parts of Sullivan County a few areas are included that contain much reddish-brown micaceous gravel in the upper part of the substratum, and here the soil resembles the Jaffrey soils. Areas having boulders on the surface and in the soil are shown on the soil map by symbols.

This soil occurs in the central and eastern parts of the area, associated with the Charlton, Marlow, and Hermon soils. The total area is 24.3 square miles. Most of the individual bodies are small. The land is rolling or hummocky, and short slopes as steep as 40 percent are common. Although drainage is excessive, the soil has a better water-holding capacity than Danby loamy sand.

Most areas are timbered, but some are included in pastures. The most common trees in forested areas are white pine and aspen. Poverty oatgrass, broomsedge, and witchgrass are common in pastured areas, and hardhack, juniper, blueberries, cinquefoil, ferns, mosses, aspen sprouts, and white pine seedlings are prevalent pasture pests. This soil furnishes very little grazing during the summer, but it is a useful addition to pastures, as it affords grazing early in the spring when other soils are soft.

Some areas have pits from which sand and gravel are excavated for commercial purposes.

Danby gravelly fine sandy loam.—This soil is similar to Danby gravelly sandy loam, except that the texture of the surface and subsoil is fine sandy loam. It occurs more commonly in association with the Marlow soil and has a total area of 9 square miles.

As this soil has slightly better moisture-holding capacity than Danby gravelly sandy loam, it returns slightly higher and more certain yields of crops.

Many areas have pits from which sand and gravel are excavated for commercial purposes.

Jaffrey gravelly sandy loam.—This soil resembles Hinckley gravelly fine sandy loam, but it is developed from material composed partly of reddish-brown micaceous schist. In forested areas a 2- or 3-inch surface mat of partly decomposed leaves and twigs overlies a 1- or 2-inch surface layer of mineral soil consisting of light-gray

mellow sandy loam or loamy sand. The subsoil to a depth of 5 or 6 inches is dark coffee-brown mellow loam. In cleared areas the materials in these three layers have been mixed by cultivation or pasturing to form dark-brown mellow fine sandy loam. Beneath this and continuing to a depth of about 15 inches the subsoil is brown fine sandy loam, and the lower subsoil layer, which extends to a depth of 30 to 36 inches, is loose yellowish-brown gravelly loamy fine sand. The substratum is imperfectly assorted sand and gravel containing many fragments of reddish-brown micaceous schist. In most places gravel makes up more than 10 percent of the surface soil and subsoil, but in a few places these layers are almost free of gravel. The reaction is very strongly acid to extremely acid throughout. The consistence of all layers is single grain to massive. Included with this soil in mapping are some areas of gravelly fine sandy loam that are not sufficiently important to be mapped separately.

Jaffrey gravelly sandy loam has a rolling to hummocky relief with many short slopes as steep as 40 percent. It is associated with the Brookfield soils and has developed from gravelly material deposited in kames. In most places this material is derived largely from reddish-brown micaceous schist, but in some places the petrographic complex includes only about 10 percent of fragments of this rock. The remaining gravel is of granitic origin in most places, although in some places there are many fragments of slaty schist. Most of the individual bodies are small, and the total area is 2.6 square miles. This soil occurs only in Cheshire County.

As the soil is well to excessively drained, only drought-resistant plants survive.

Most of the land is forested, but some is included in pastures or cultivated fields. White pine and aspen are the most common trees on this soil, and the common pasture grasses are poverty oatgrass and broomsedge. Hardhack, blueberries, cinquefoil, ferns, mosses, aspen sprouts, and white pine seedlings grow in most of the pastures. This soil furnishes very little grazing during the summer; nevertheless it is an asset to many pastures, as it warms early in the spring and furnishes grazing when other soils are soft. The cultivated part consists of a few small areas that are included in fields consisting largely of other soil types, and no precise data regarding crop yields and agronomic practices are available. Yields of crops are low, and failures are common.

Sand and gravel for commercial purposes are excavated from pits in this soil. This material cannot be used successfully in concrete work, as the schist fragments are soft, and for the same reason roads surfaced with it are dusty when dry and slippery when wet.

SOILS FROM WIND-BLOWN DEPOSITS

Soils developed from wind-blown deposits include only Windsor loamy fine sand and its eroded phase. During the retreat of the glaciers that once covered New England, the winds were very strong around the edge of the ice, even as they are today in Greenland and the Antarctic. The westerly winds picked up fine sands from the outwash plains along the streams and drifted them along the edge of the uplands bordering the plains. This material has given rise to the Windsor soils.

Windsor loamy fine sand.—The surface soil of Windsor loamy fine sand is grayish-brown loose loamy fine sand or loamy sand, about 5 inches thick. The subsoil is light-brown or yellowish-brown loose loamy fine sand or loamy sand to a depth of 12 to 15 inches. Below this the lower subsoil layer is grayish-yellow loose loamy fine sand or sand. At a depth of 25 to 30 inches the subsoil rests on the substratum of gray loose fine sand or sand containing many black particles. The materials in all layers have no definite structure, and the reaction ranges from extremely acid (pH 4.0) in the surface soil to very strongly acid (pH 4.5) in the substratum.

This soil is associated with the Agawam soils bordering the Connecticut Valley, where it occupies undulating areas having a maximum slope of about 12 percent. Most of these areas are at the base of the hilly uplands. A total area of 3.2 square miles is mapped.

Windsor loamy fine sand is excessively drained and has poor water-holding capacity. Most areas are forested with white, red (Norway), and pitch pines, together with some red oak, red maple, black locust, and black cherry. A few areas are used as pasture, and some are cultivated. Grazing is poor, yields are low, and great care must be taken to prevent wind erosion.

Windsor loamy fine sand, eroded phase.—This soil consists of grayish-yellow loose loamy fine sand, fine sand, or sand. It occupies small areas at the edges of the uplands bordering the Connecticut River terraces. All these areas are open (blow-outs) or are very sparsely covered with bunchgrass and scrub white pine. The total area is only 0.8 square mile and is all wasteland.

SOILS OF THE NEARLY LEVEL TERRACES AND OUTWASH PLAINS

The soils of the nearly level terraces and outwash plains have formed from materials deposited by the waters of receding glaciers. At the time the great glaciers of New England were melting and the ice front was gradually receding toward what is now Canada, the waters from the melting ice filled depressions in front of the ice and followed channels southward toward the sea. Fine sediments were carried in suspension by the waters; coarser rock particles and boulders were carried or rolled by the swiftly moving water in the outwash channels. The finer sediments were transported to the still waters of lakes, where they settled out to form laminated deposits of silts, fine sands, and clays; the coarser sediments were laid down in beds along the channels. Many of the lakes were drained by natural means after the disappearance of the ice, and the old outwash channels have been dissected by streams. Now the silty and clayey lake deposits and coarse sandy and gravelly outwash deposits form nearly level terraces that lie well above the level of present streams and are no longer subject to overflow. The soils of this group are placed in three subgroups, as follows: (1) Soils over fine-textured (lake-laid) materials; (2) soils over medium-textured (stream-terrace) materials; and (3) soils over coarse-textured (outwash) materials.

SOILS OVER FINE-TEXTURED (LAKE-LAID) MATERIALS

The Suffield, Hartland, and Melrose soils, occurring near the Connecticut River, have developed from fine-textured (lake-laid)

materials deposited when that section was submerged or during high floods of the glacial epoch. The Melrose and Suffield soils occupy nearly level areas; the Hartland soils, on the other hand, occupy gently undulating areas. Combined, these soils cover a small total area. The substrata are thinly stratified very fine sand, silt, and clay. Those underlying the Melrose and Suffield soils are largely clay; whereas those underlying the Hartland soils include a large quantity of silt and very fine sand.

The Suffield soils have grayish-brown surface soils to a depth of about 7 inches and yellowish-brown or olive-yellow subsoils that extend to a depth of about 20 to 24 inches, where the thinly bedded substrata occur. Suffield silt loam is the only type mapped in these counties.

The Hartland soils have brown surface soils extending to a depth of about 9 inches, and the subsoils, which reach to a depth of about 24 inches, are yellowish brown. The substrata are thinly bedded very fine sand and silt, together with a few layers of clay. Hartland very fine sandy loam and its broken phase are mapped only in Sullivan County.

The Melrose soils have developed where a thin deposit (less than 4 feet thick) of sandy material overlies the heavy substrata. The surface soil to a depth of about 8 inches is brown, and the subsoil is yellowish brown, grading to grayish yellow above the heavy substrata. Melrose fine sandy loam is the only soil type mapped in this series.

Suffield silt loam.—The surface soil to a depth of 7 or 9 inches is dark-gray or brownish-gray silt loam having a soft-crumb structure. The subsoil, which reaches to a depth of 15 to 20 inches, is grayish-brown firm silt loam or silty clay loam that has a firm-crumb to fragmental structure and is plastic when wet. Below this the substratum consists of thinly interbedded silt and clay, together with a few thin layers of fine sand or very fine sand. All layers are strongly acid to very strongly acid.

Included with this soil is an area 1½ miles northwest of North Charlestown and a few areas in other parts of the Connecticut Valley in which the subsoil is slightly mottled with rust brown. Also included with this soil are a few small areas in the vicinity of Kelleyville and one near Swanzey Lake, which have sand or gravel at a depth of about 3 feet.

Almost all of the areas of this soil are in the valley of the Connecticut River, but a few are in the valleys of the smaller streams. Several areas are along the Sugar River south of Newport. The total area is 1.4 square miles.

The land is flat or nearly flat, and the maximum slope is less than 5 percent. This soil has developed from material deposited in very quiet water, probably a lake, during the period when the glacier was melting or very shortly thereafter. Drainage is fair but very slow. Water never stands on typical areas of this soil situated on a bench, although it does on some of the mottled inclusions. Many areas have been artificially drained with open ditches. Very little water can move through the heavy substratum, but the soil and substratum are retentive of moisture, so that crops are not injured during dry periods.

Most areas of this soil are used as hay meadows and are plowed only when the yield falls below 1½ tons an acre, but a few areas are used as pasture. None of the land, except very small isolated areas, is allowed to remain idle or in timber. Hay yields from 2 to 3 tons an acre, and 3 acres of pasture furnishes sufficient grazing for a cow.

Hartland very fine sandy loam.—The 7-inch surface soil is dark-gray or dark-brown very fine sandy loam, and the subsoil to a depth of 24 to 30 inches is yellowish-brown or grayish-brown very fine sandy loam. Both these layers are mellow and have no definite structure. In most places the substratum is yellowish-brown or olive-gray interbedded fine sand, silt, and clay, although in some places it is loamy fine sand. The upper part of this soil is strongly acid, but in some places the substratum at a depth of 10 to 12 feet is neutral or slightly alkaline. Generally no stones or gravel are in the soil or on the surface, but in some places a few stones lie on the surface. Included with this soil in mapping are a few areas in the vicinity of Newport having a 1-inch surface layer that is light gray or nearly white and a dark-brown subsoil that extends to a depth of 4 or 5 inches.

This soil occurs along the Connecticut River in Sullivan County and along a few smaller streams. It represents what may be the eroded remains of old terraces of the Agawam soils. The total area is only 2.5 square miles.

This gently undulating land has an average slope of about 15 percent. Drainage is good, but water moves slowly through the deep substrata.

Most of this soil is used as pasture, as it generally occupies areas that are too narrow to be cultivated economically. Many good pastures are on this soil. Kentucky bluegrass and bentgrass are the most common grasses, but some pastures contain much witchgrass and poverty oatgrass. Sweetfern is a serious pest in most pastures. About 2 acres of pasture is required for each cow.

Included with Hartland very fine sandy loam on the soil map are a few small areas of Hartland silt loam. In these areas the surface soil is grayish-brown silt loam to a depth of about 7 inches, and the subsoil, to a depth of 15 to 20 inches, is yellowish-brown friable heavy silt loam. Beneath this and extending to a depth of 25 to 30 inches the subsoil is greenish-yellow or olive-gray silt loam, and the substratum is interbedded silt and clay with thin layers of very fine sand.

This included soil occurs in the valley of the Connecticut River, especially near Claremont Junction. It represents what are probably eroded areas of Suffield silt loam. Surface drainage is good to excessive, but water moves very slowly through the soil. The water-holding capacity is good, so that plants seldom wilt, even in very dry periods. Most of these included areas are used as pasture, but a few are mowed. It furnishes very good grazing, and 3 acres are sufficient for a cow.

Hartland very fine sandy loam, broken phase.—This soil represents the very steep edges of Hartland soil areas where the drop to a lower terrace is precipitous. The surface soil and the subsoil are clay. In most places the raw substrata are exposed, and rock ouctrops

in a few areas. This soil occurs in association with typical Hartland very fine sandy loam and with Suffield silt loam. The total area is only 0.4 square mile in Sullivan County.

None of this soil is farmed. It is undesirable in pastures, as it furnishes little grazing and may be the starting point of gullies that cut back into desirable soil areas. Some areas are forested and support fair stands of white pine, red oak, yellow birch, sugar maple, white ash, American linden or basswood, and hophornbeam.

Melrose fine sandy loam.—The 6- or 7-inch surface soil is brown or dark-brown mellow fine sandy loam having no apparent or soft-crumb structure. The subsoil to a depth of 20 to 30 inches is grayish-yellow loamy fine sand or fine sandy loam with no definite structure. In most places this layer is faintly mottled, and in some places it is highly mottled with gray and brown in the lower part where it rests on the interbedded silt and clay substratum. The depth to the heavy substratum ranges from a few inches to as much as 6 feet, but in most places it is less than 3 feet. In some places there is some gravel in the surface soil and subsoil; in others the texture of the surface soil and subsoil is very fine sandy loam.

The total area of Melrose fine sandy loam is only 0.6 square mile. Small areas are scattered over the Connecticut Valley, particularly in the vicinities of Plainfield and Claremont.

The land is almost level, but water does not stand on the soil, as it occurs on bench or terrace formations. Water moves quickly through the surface soil and subsoil, although the substratum is practically impervious.

This soil has developed where sand or gravel was deposited on heavy materials similar to those from which Suffield silt loam has developed.

The individual bodies are small and are used in conjunction with adjoining soils as cropland or pasture. This is considered a desirable soil, but the total area is so small that precise yields and cropping practices cannot be ascribed to it.

SOILS OVER MEDIUM-TEXTURED (STREAM-TERRACE) MATERIALS

Soils over medium-textured (stream-terrace) materials are members of the Agawam series. These soils now lie above the level of overflow on the terraces of the Connecticut River. They have brown surface soils, yellowish-brown subsoils, and olive-gray friable subsoils. Agawam fine sandy loam, Agawam very fine sandy loam, and Agawam loamy fine sand and its broken phase are mapped.

Agawam fine sandy loam.—The 7- to 9-inch surface soil is brown or dull-brown very mellow fine sandy loam having no definite structure. To a depth of 15 to 20 inches the subsoil is yellowish-brown mellow fine sandy loam of single-grain consistence. Below this and continuing to a depth of 30 to 40 inches the subsoil consists of grayish-yellow or olive-colored mellow sandy loam, in many places streaked with brown. The structure when present is weakly platy. Generally the substratum is gray loose fine sand or loamy fine sand, but in some places it is sand or very fine sand. The soil in all layers is medium acid in reaction.

In some places a layer, about 1 inch thick, of gray loamy fine sand forms the surface layer, and the subsurface layer is dark brown to a

depth of 2 or 3 inches, but these layers persist only in old fence rows or roadside areas that have not been plowed.

Agawam fine sandy loam occurs on nearly flat terraces in the Connecticut Valley. It has developed from sediments consisting largely of schist material deposited in comparatively quiet water. Although the total area is only 5.2 square miles, this soil is very important agriculturally. Practically all of it is cultivated, and it is one of the most productive soils in New England. Water percolates readily through the porous surface soil and subsoil and does not stand on the surface, even though runoff is slow. Crops seldom wilt during dry periods, because the water table lies comparatively close to the surface, so that water is supplied to plants by capillary action. Corn and oats are grown extensively, but about one-half of the area is used as hay land. Very little of it is used as pasture, because less productive hilly land is available in most places. A common rotation is corn, oats, and hay (2 years). Manure is applied to sod before plowing the land for corn, and 300 to 500 pounds of superphosphate is added when corn is planted. Corn yields 35 to 60 bushels of grain or 10 to 16 tons of silage, oats about 40 to 45 bushels, and hay 1½ to 3 tons to the acre. Some hayfields are top-dressed with manure after the first crop. Many hay meadows are allowed to stand 3 or 4 years, and manure is used as a top dressing after the second crop is cut. Some potatoes are grown, but the quality is thought to be lower than the quality of those produced at higher elevations. Yields range from 200 to 350 bushels an acre, depending on the season and the quantity of fertilizer used.

Practically all of the plowing is done in the fall; and, as this soil is very well drained and warms early in the spring, crops can be planted early. One undesirable feature of this soil is that in some places a rusty plow will not scour.

Agawam very fine sandy loam.—The 6- or 8-inch surface soil is brown mellow very fine sandy loam that in some places has a soft-crumb and in others no definite structure. To a depth of 10 to 12 inches the subsoil is yellowish-brown firm but friable very fine sandy loam with massive consistence. Beneath this the lower subsoil layer is grayish- or yellowish-brown very fine sandy loam, which becomes gray at a depth of 24 to 30 inches. This material rests, at a depth of 36 to 40 inches, on the strata of interbedded fine sand, very fine sand, and some silt. At a depth of 6 to 8 feet the strata consist of loose sand or fine sand, but in some places there are interbedded layers of silt and clay. All layers of the soil are medium acid in reaction, except in some places where the lower part of the parent material is alkaline.

Agawam very fine sandy loam is associated with Agawam fine sandy loam on the terraces of the Connecticut River. A large area is in Walpole just south of the point where the Clear River enters the Connecticut River. The total area is 3.3 square miles.

This soil is similar to Agawam fine sandy loam in agricultural suitability and fertilizer requirements, but yields are slightly higher in average seasons and may be much higher in very dry seasons.

Agawam loamy fine sand.—The 6- or 7-inch surface soil is brown loamy fine sand having no apparent structure. The subsoil, which reaches to a depth of about 20 to 30 inches, is loose grayish-yellow or

brownish-yellow loamy fine sand with no definite structure. The substrata are gray to olive-gray loamy fine sand, fine sand, and sand. In most places there are many mica flakes in the substrata. All layers are medium to strongly acid, the pH value being about 5.5.

Included with this soil in mapping are a few areas south of Charlestown, where bedrock lies close to the surface and outcrops in many places. Also included is an area in the extreme southwestern part of Cheshire County that has a fine sandy loam surface soil and subsoil but a very loose sandy substratum at a depth of about 20 inches. This area is less resistant to drought and leaching than typical Agawam fine sandy loam and has been included within the loamy fine sand for this reason.

Agawam loamy fine sand occurs on the nearly level terraces of the Connecticut River in association with other Agawam soils. The total area is 4.3 square miles. Water percolates rapidly through the soil, but runoff is slight. During long dry periods, plants on this soil wilt.

Practically all of this soil is cultivated. Corn, oats, hay, and vegetables are the important crops grown. Formerly tobacco was grown in the vicinity of Hinsdale. Heavy applications of manure are made where it is available. Small quantities of complete fertilizer are used each time crops are seeded, as the unused residue leaches away. In addition to the manure, about 300 pounds an acre of superphosphate or 4–12–4 mixed fertilizer is applied for corn and about 300 pounds of 4–12–4 for oats. Corn yields about 8 tons of silage or 35 bushels of grain, and oats about 35 bushels an acre. Applications of fertilizer for vegetables vary from farm to farm. Timothy and clover are common hay crops, and some alfalfa is grown. The meadows are top-dressed with manure if it is available, and lime is applied before seeding the land to alfalfa. Alfalfa yields range from 1½ to 2½ tons an acre in new seedings but fall to less than 1 ton in a few years if the land is not fertilized.

As this soil is subject to wind erosion, it should have a cover as much of the year as possible.

Agawam loamy fine sand, broken phase.—This soil occurs on the steep edges of all terraces occupied by the Agawam soils. No definite profile exists, as the substratum is exposed in many places; nevertheless in most places a 3- to 6-inch layer of brown soil, the texture depending on that of the adjoining soil, overlies the substratum. In general, areas of this soil are very narrow strips showing the location of a steep drop or escarpment from one terrace to the flood plain or to a lower terrace. Some areas, however, are larger, chiefly where small V-shaped valleys have cut back into the terrace. Some of these have cut a short distance into areas of Merrimac soil, and in these places the edges of the gravelly Merrimac soils are included with this soil in order to simplify the map.

Some areas having a series of short, steep slopes and narrow, flat benches are mapped; others represent places where the terrace has eroded back to the edge of the uplands, leaving but little assorted material against the hill. In some of these places the fine material may have been blown against the hillside. One area that illustrates this origin is north of Hinsdale, where fine material has been deposited by wind and water in a rocky area including numerous outcrops. Here, the growth is scrub oak, aspen, blueberries, and sweetfern.

This soil is widely distributed throughout the Connecticut Valley and has a total area of 6.4 square miles.

Most of this land is in pasture, but some areas are in timber, and some are incorporated in fields, where they are a hindrance to cultural operations, as they never are plowed. Many of the areas in pastures have bare spots, and none furnish good grazing. Witchgrass is common; and sweetfern, hardhack, and juniper are present in many areas.

SOILS OVER COARSE-TEXTURED (OUTWASH) MATERIALS

All the soils over coarse-textured (outwash) materials are situated on the terraces of the larger streams. Many areas have been farmed continuously for almost 200 years because the nearly level and stone-free land required less labor to clear the land and prepare it for cultivation than did the soils of the stony and hilly uplands. A large part of this land is still cultivated or used as pasture, although many areas of the sandier soils are forested. Vegetables are grown in small plots near the larger villages, but general farming, with emphasis on dairying, is practiced on most areas. Corn for grain and silage, oats, and hay are the common crops. Potatoes are grown for home use on most farms, and a few commercial growers use these soils. These soils are not so fertile as the heavier textured soils and are subject to drought; nevertheless they can be plowed in the fall, warm early in the spring, and respond to fertilization. Productivity can be built up and maintained by proper farming methods. Fertilizer is applied sparingly to each crop, as the soils are leachy and the residual effect is small.

The soils included in this group are members of the Merrimac, Adams, Colton, and Sudbury series.

The Merrimac soils have weak-brown surface soils, brownish-yellow subsoils, and grayish-yellow or gray loose gravelly or sandy stratified substrata. Merrimac fine sandy loam, Merrimac gravelly fine sandy loam, Merrimac loamy sand, and Merrimac gravelly loamy sand together with its broken phase are recognized in the Merrimac series.

Adams loamy fine sand, the only type of the Adams series mapped, resembles the Merrimac soils but has no gravel in the soil or substratum. The surface soil is weak-brown, the subsoil brownish-yellow, and the substratum gray or grayish-yellow loose sand.

In cultivated fields the Colton soils resemble the Merrimac soils, but in forested areas there is a mat of organic matter on the surface, the mineral surface soil is light gray, the upper subsoil layer is brown, the lower subsoil is yellowish brown, and the substratum is loose stratified sand and gravel. Colton sandy loam, Colton gravelly sandy loam, and Colton loamy sand are the members of this series mapped

Sudbury fine sandy loam, the only type of the Sudbury series mapped, is an imperfectly drained soil with a grayish-brown surface soil, gray or mottled gray and brown subsoil, and gray or mottled gray and weak-brown sandy or gravelly substratum.

Merrimac fine sandy loam.—The 6- to 8-inch surface soil is weak-brown mellow fine sandy loam with no definite structure, and the upper subsoil layer, to a depth of 15 to 20 inches, is yellowish-brown firm but friable fine sandy loam showing little evidence of structure. The lower subsoil layer is brownish-yellow loose gravelly loamy sand.

At a depth of 25 to 30 inches it rests on the substratum of loose stratified sand and gravel. The reaction is medium to strongly acid throughout.

This soil occurs on terraces of the larger streams and on the high terraces in the Connecticut Valley. The total area is 6.5 square miles. The substrata of the soil in the Connecticut Valley and on the lower reaches of the smaller streams in the western part of the area contain a large proportion of schist fragments and in many places many disintegrated fragments of calcareous schist. In some places, at a depth of 6 to 10 feet, the gravelly substratum is weakly cemented by calcium carbonate. The substrata of Merrimac fine sandy loam in the vicinity of soils derived from granitic rock debris are composed almost entirely of granitic gravel. Included with this soil are many areas of Merrimac sandy loam.

This soil is well drained and has a fair water-holding capacity, but plants wilt during prolonged dry periods, and crops may fail. Very little water runs off the surface, as the soil is very porous.

Most of this soil is cultivated, although some areas are used as pasture and a few are forested. Corn, oats, and hay are the principal crops, and in some places vegetables are grown for sale in nearby markets. Large quantities of manure are applied to sod before plowing for corn, and about 300 pounds of superphosphate or 4–12–4 mixed fertilizer is applied when corn is planted. Average yields are between 25 and 40 bushels of grain or 8 and 9 tons of silage. From 200 to 300 pounds of 4–12–4 mixed fertilizer may be sown with oats, and the yield is about 25 to 35 bushels an acre. Clover, timothy, and redtop are grown for hay, yielding 1 to 1½ tons. If the mowings are allowed to stand more than 2 years, they are top-dressed with manure. Most fields are plowed after 1 or 2 hay crops, as they soon run out and become weedy.

Most of the areas in pasture or forest are in inaccessible positions or are too narrow to be cultivated profitably. Bentgrass, bluegrass, poverty oatgrass, witchgrass, and broomsedge, together with the pests—hardhack, sweetfern, blueberries, and mosses—grow in most pastures, and from 4 to 8 acres of land is required to furnish pasture for each cow. White pine, oak, and sugar maple are the most common trees in the forested areas.

There are many pits in this soil from which sand and gravel are excavated for commercial purposes.

Merrimac gravelly fine sandy loam.—This soil is similar to Merrimac fine sandy loam, except that gravel makes up more than 10 percent of the surface soil and subsoil. The soil is associated with Merrimac fine sandy loam and covers a total area of 8.2 square miles.

With the exception of a few areas that have more than 40 percent of gravel in the surface soil, this soil has nearly the same crop-producing capabilities as Merrimac fine sandy loam and is managed in the same way. Most of the very gravelly areas are forested, as they are less drought-resistant than the others. White pine commonly grows on these areas.

There are many pits in areas of this soil from which sand and gravel are excavated for commercial purposes.

Merrimac loamy sand.—In forested areas the 2- or 3-inch surface soil is dark-brown loamy sand. The upper subsoil layer,

extending to a depth of 6 or 7 inches, is brown loamy sand. In cleared areas these two layers are mixed by cultivation or pasturing to form brown loose loamy sand without definite structure. The lower subsoil layer, to a depth of 15 to 18 inches, is yellowish-brown loose or very slightly coherent loamy sand, which grades, at a depth of 20 to 24 inches, into brownish-yellow or grayish-yellow loamy sand having no definite structure. The substratum comprises loose sand and small particles of gravel, in most places stratified. Small quantities of gravel are in all layers, and the substratum of many areas is composed largely of small pieces of gravel. The reaction is strongly acid throughout. Included with this soil are some areas of loamy coarse sand and a few of loamy fine sand.

Merrimac loamy sand is in the western and southern parts of the area on stream terraces and on the high terraces of the Connecticut River. The largest areas are in the vicinity of Keene. The total area is 8.7 square miles.

Most of the land is nearly level, but some areas are very gently undulating or billowy. This soil has developed from sediments deposited in glacial lakes or streams and is derived largely from granitic sources. It is very open and porous. Water moves rapidly through the soil, but there is practically no runoff even during very hard rains.

Practically all of the land was cultivated during colonial times, but now many areas are forested. White pine and scrub oak are common in forested areas, and there are many pure stands of even-aged white pine. The common pasture grasses are poverty oat-grass and broomsedge. Hardhack, sweetfern, blueberry bushes, cinquefoil, sorrel, and pine seedlings have invaded most pastures. Very little grazing is furnished during the summer, but pastures on this soil can be used early in the spring. Many gardens are situated on this soil, and, if large quantities of manure are added and cover crops grown, high yields are returned. In general, however, yields are low and vary directly with the quantity of rainfall received during the growing season. Crop failures are common, but, when heavy applications of manure are plowed under and 300 to 500 pounds of superphosphate or 4–12–4 mixed fertilizer added when corn is planted, yields as high as 25 to 30 bushels of grain or 6 to 8 tons of silage are returned. About 200 pounds of 4–12–4 mixed fertilizer is applied when oats are sown, and the yield is 25 to 30 bushels. Timothy and redtop are the most common grasses grown for hay, which yields from ¾ to 1 ton an acre. Some alfalfa is grown where lime is used before seeding.

Wind erosion is severe on some areas, but this soil can be plowed in the fall with little danger of erosion by water.

There are many pits in this soil from which sand and gravel are excavated for commercial purposes.

Merrimac gravelly loamy sand.—This soil is similar to Merrimac loamy sand, except that small gravel is abundant on the surface, in the surface soil, and in the subsoil. In most places the gravel constitutes 10 percent or more of the material. Merrimac gravelly loamy sand occurs in the vicinity of Keene. It is associated with Merrimac loamy sand and has a total area of 2.2 square miles.

This soil is utilized in the same manner as Merrimac loamy sand, and crop yields and agronomic practices are similar on the two soils.

From the many pits in this soil, sand and gravel are excavated for commercial purposes.

Merrimac gravelly loamy sand, broken phase.—Areas of this soil comprise broken edges of the terraces occupied by the Merrimac soils. In many places no true soil profile exists, but the grayish-yellow gravelly substratum is exposed at the surface; and in many places a 3- or 4-inch layer of weak-brown loamy sand lies on the surface. A total area of 2.9 square miles is mapped in Cheshire County, mainly in the Connecticut Valley.

Slopes as steep as 40 percent are common. Most of this soil is forested, although some areas are included in pastures. White pine and oak are the common trees in the forested areas. Poverty oat-grass and broomsedge are common pasture grasses; and sweetfern, hardhack, and brier are pests in most pastures. Grazing is very poor during the summer.

Sand and gravel are excavated for commercial purposes from the many pits in this soil.

Adams loamy fine sand.—This soil resembles Merrimac loamy sand except for the absence of gravel in the Adams soil. The 3- or 4-inch surface soil is dark-brown loose loamy fine sand without definite structure. The upper layer of the subsoil, which reaches a depth of 10 to 15 inches, is yellowish-brown loose loamy fine sand having no definite structure. The lower subsoil layer consists of grayish-yellow loose loamy fine sand or sand. At a depth of 20 to 30 inches it rests on the substratum of gray fine sand or sand. The reaction is strongly acid throughout. Included with this soil are some areas of Adams loamy sand. In most places the sand is formed from sediments derived from granitic rock; in the Connecticut Valley, particularly in the area about 2 miles north of Charlestown, some sand of schist origin is included and the substratum is a salt-and-pepper colored mixture of sands. In the latter area the subsoil is slightly loamier than is typical for Adams loamy fine sand.

This soil, associated with the Merrimac soils on nearly flat stream terraces, has a total area of 3.8 square miles.

Practically all of the land is forested, as it is excessively drained and crops wilt and may fail in dry seasons. The most common forest tree is white pine, and many stands are almost pure. In some places, however, there are some scrub oak and aspen. Broomsedge is common in abandoned fields and in open stands of white pine.

Colton sandy loam.—In cultivated fields the Colton soils resemble the Merrimac soils, but in forested areas a 3- to 5-inch layer or mat of partly decomposed organic matter lies on the surface. The mineral surface soil to a depth of 2 or 3 inches is light-gray or nearly white loose sandy loam without definite structure, and the upper subsoil layer to a depth of 6 or 7 inches is brown or coffee-brown friable sandy loam without definite structure. In cleared areas these layers are mixed by cultivation or pasturing to form a brown mellow sandy loam having no definite structure. To a depth of 24 to 30 inches the lower subsoil layer is yellowish-brown or brownish-yellow mellow sandy loam or loamy sand without definite structure. The substratum is gray or grayish-yellow stratified sand and gravel. Throughout the soil the reaction is strongly to very strongly acid except in some places where the substratum is medium acid. Included with this soil

in mapping are some areas of Colton fine sandy loam. In some forested areas the upper part of the subsoil is slightly indurated and may be very hard when dry.

In the vicinity of Goshen village a thin deposit, less than 3 feet thick, of gravelly material, from which this soil has developed, overlies till similar to that from which the Essex soils have developed. It also overlies bedrock in a few spots. The upper part of Colton sandy loam is developed in these places over the till or bedrock substratum. In a few small spots, however, it has washed away, thereby exposing the compact till or bedrock. In some districts where the Brookfield soils occur, large quantities of mica are present in the soil and substratum and the substratum is yellow.

This soil is mapped on terraces in districts where the Hermon and in some places the Marlow, Essex, Gloucester, and Brookfield soils occur. The total area is 4.2 square miles.

Some of this soil is cultivated or used as pasture, but most of the land is forested. The soil is comparable to Merrimac fine sandy loam in crop adaptations, although it is slightly less drought-resistant and produces slightly lower crop yields. Corn, oats, and hay are the principal crops. Heavy applications of manure are made before plowing for corn, and 300 to 500 pounds of superphosphate or 4–12–4 mixed fertilizer is applied when corn is planted. Yields average between 20 and 30 bushels of grain and between 5 and 8 tons of silage. Land in oats may receive 200 to 300 pounds of 4–12–4 mixed fertilizer, although this crop may be planted without fertilization. Yields are about 20 to 30 bushels an acre. Timothy and redtop are the most common grasses grown for hay, which yields 1 to 1½ tons an acre from new seedings. If the meadows are maintained for more than 2 years they are top-dressed with manure. Some meadows have been mowed for several years and have become very weedy. Poverty oatgrass and broomsedge are the most common grasses in pastures and abandoned mowings. They furnish poor grazing, especially during the summer. Hardhack, juniper, ferns, mosses, blueberry bushes, aspen sprouts, and other brush have invaded most pastures. White pine, hemlock, aspen, and sugar maple are the most common trees in the forested areas.

There are many pits in areas of this soil from which sand and gravel are excavated for commercial purposes.

Colton gravelly sandy loam.—This soil is similar to Colton sandy loam, except that gravel represents 10 percent or more of the soil mass in all layers. A total area of 2.6 square miles of this soil is mapped, mainly in association with Colton sandy loam. Included with this soil are a few areas in the vicinity of Newport, which are underlain by strata of silt and clay.

Except for a few areas that contain more than 40 percent of gravel in the surface soil, Colton gravelly sandy loam has nearly the same crop-producing capabilities as the sandy loam and is handled in the same way. Most of the very gravelly areas are forested, as they are more droughty than the other areas. White pine is the most common tree in the forested areas.

Sand and gravel are excavated for commercial purposes from the many pits in this soil.

Colton loamy sand.—This soil has a color profile similar to that of Colton sandy loam, but in cleared areas it resembles Merrimac

loamy sand. In forested areas a mat, 2 to 5 inches thick, of very dark-brown partly decomposed organic matter lies on the surface. The mineral surface soil to a depth of 2 or 3 inches is gray or nearly white loose loamy sand or sand without definite structure. To a depth of 5 to 7 inches the subsoil is dark-brown or coffee-colored firm massive loamy sand. In cleared areas these layers are mixed by cultivation or pasturing to form dark-brown or brown loamy sand having single-grain consistence. Below this and continuing to a depth of 30 to 36 inches the subsoil is yellowish-brown or brownish-yellow loose loamy sand having single-grain consistence. The substratum is grayish-yellow loose sand or sand and small gravel. Throughout the soil the reaction is strongly to very strongly acid. In some forested areas the upper part of the subsoil, between depths of about 3 and 6 inches, is very hard when dry. Very little gravel is present in the surface soil or in the subsoil, and most of the individual pebbles are less than half an inch in diameter. Included with mapped areas of this soil are some areas of loamy coarse sand and a few of loamy fine sand.

Colton loamy sand is assocated with Colton sandy loam. It has a total area of 3.6 square miles.

Practically all of the land is forested, as it is subject to wind erosion when pastured heavily or cultivated. White pine and aspen are the principal trees. Poverty oatgrass and broomsedge are the most common grasses in the pastured areas and open forests. Hardhack, juniper, ferns, mosses, aspen sprouts, and white pine seedlings have invaded most pastures. Vegetables, corn, oats, and hay are grown on the cultivated areas, but yields are low and crop failures common, as the soil is very droughty.

There are some pits in this soil from which sand and gravel are excavated for commercial purposes.

Included on the map with Colton loamy sand are several areas in which gravel makes up 10 percent or more of the surface soil and subsoil. This inclusion, associated with the other Colton soils, has a total area of about 1¼ square miles. Practically all of this included soil is forested, as it has the same limitations for producing crops as the typical loamy sand. White pine and aspen are the most common trees. As in the typical soil sand and gravel are excavated from many pits for commercial purposes.

As mapped, Colton loamy sand also includes the steep edges of all the terraces occupied by the Colton soils. In these places no definite soil profile exists, as the gravelly substratum is exposed in many places; but on much of the land there is a 3- or 4-inch surface layer of dark-brown sandy loam. This inclusion covers only about 25 acres. Most of it is forested, but some areas are in pasture. In the forested areas white pine, aspen, and oak are the principal trees. Poverty oatgrass and broomsedge are the most common grasses in the pastures, but they furnish very poor grazing. Hardhack, blueberry bushes, briers, juniper, ferns, mosses, aspen sprouts, and other brush are present in most pastures. There are pits in areas of this soil from which sand and gravel are excavated for commercial purposes.

Sudbury fine sandy loam.—The 3- or 4-inch surface soil is very dark-gray mellow fine sandy loam. This material has no well-defined structure. It is underlain to a depth of 5 to 7 inches by grayish-brown mellow fine sandy loam that is mottled with gray and brown

and has no well-defined structure. The subsoil, to a depth of about 10 inches, is gray mellow fine sandy loam with a soft-platy structure. Below this and continuing to a depth of 17 to 20 inches the material is bright yellowish-brown mellow fine sandy loam, faintly mottled with rust brown and grayish brown, that has no well-defined structure. These layers are very irregular in thickness. One may be 2 inches thick and another 10 inches, and less than 1 foot distant the ratio may be reversed. In general, the substratum is grayish-yellow or olive firm fine sandy loam or loam mottled with gray and streaked with light rusty brown, but in many places the substratum is stratified sand and gravel. The reaction is strongly acid to very strongly acid in all layers. In some places the subsoil is highly mottled gray, yellowish brown, and rust brown from the surface downward, whereas in others a 6- to 10-inch layer of unmottled brownish-yellow fine sandy loam lies between the surface soil and the mottled layers. Some areas of sandy loam, loamy sand, and loamy fine sand are included with this soil on the map.

This soil, which is imperfectly drained, is situated on the larger terraces near the edge of the uplands or in slight depressions within areas of Merrimac or Colton soils. It has a total area of 1.1 square miles.

Most of this soil is used as pasture and furnishes excellent grazing even during dry seasons. A few areas are cultivated, and some are forested. Most of the pastures are nearly free of weeds and pests. Creeping bentgrass, Kentucky bluegrass, and Canada bluegrass are the most common grasses in the pastures. Some corn (for silage), oats, and hay are grown on the better drained areas, but the acreage is very small and definite yield records cannot be given. In forested areas the principal tree is red maple, and there is some birch, beech, and white pine. In some areas much alder brush and shadblow (juneberry) grow.

SOILS OF THE BOTTOM LANDS

Soils of the bottom lands are developing from recently deposited alluvium along the streams. These soils are subject to frequent overflow and may receive new sediments during each flood.

Two subgroups are distinguished: (1) Soils with medium-textured substrata and (2) soils with coarse-textured substrata.

SOILS WITH MEDIUM-TEXTURED SUBSTRATA

The subgroup of soils with medium-textured substrata includes members of the Hadley, Podunk, and Rumney soil series. All these soils have developed on nearly level land from material that was deposited by slowly moving water. Many areas of these soils have been farmed continuously since the first settlements were made, nearly 300 years ago, and they are still the most productive soils in the area.

The Hadley soils occur on the flood plain of the Connecticut River, but they are not inundated except during very high water. Many homes and some towns are situated on these soils. The Hadley soils have brown surface soils, grayish-brown or olive-brown subsoils, and friable olive-gray substrata. Hadley very fine sandy loam, with its low-bottom phase, and Hadley loamy fine sand, low-bottom phase, are mapped.

The Podunk-Rumney soils are complexes of imperfectly drained and poorly drained soils. Many areas are inundated with each flood, but the larger areas, such as the one in the vicinity of Keene, are comparatively free from overflow. Podunk-Rumney fine sandy loams and silt loams are mapped. The imperfectly drained Podunk soils are not separated on the map from the poorly drained Rumney soils, because they occur in such closely associated areas. Areas of these soils are valuable as hayfields, because they are nearly flat and stone free, and except where very poorly drained they are excellent soils for the production of corn.

Hadley very fine sandy loam.—The 6- to 8-inch surface soil is dark-brown or dark grayish-brown very fine sandy loam of soft-crumb structure. The subsoil is yellowish-brown, greenish-yellow, or olive-gray very fine sandy loam having no definite or soft platy structure. This layer grades into olive-gray fine sand or sand at a depth of 20 to 40 inches. The material is very slightly acid or neutral in reaction, the pH value ranging from 6.0 to 7.0.

This soil is uniformly developed over a wide area, and variations from the above description are slight. Areas that are overflowed only infrequently have developed profiles somewhat like those of the Agawam soils. The depth to the substratum ranges from 15 to 50 inches. In some places the substratum is loose sand; in others it is silty material.

This soil occupies nearly level high bottoms of the Connecticut River 20 to 40 feet above the normal level of the river, but some areas include narrow depressions that mark the location of former stream beds or swift flood currents. The soil has developed from nearly neutral or alkaline sediments derived principally from schist. The alkaline sediments come from Vermont where there are extensive areas of calcareous rocks in the part of the river basin lying within that State. Although the total area is only 3 square miles, this is a very important agricultural soil. The soil and substrata are well drained and have excellent moisture-holding capacity.

Practically all of the land is cultivated, but some areas, particularly those in which there are numerous depressions, are used as pasture. Corn, oats, and hay are the principal crops grown, and very little soil amendment other than manure is used. Manure is added to sod before plowing for corn and as a top dressing on some hayfields. On areas that have not been inundated for several seasons, superphosphate is applied when corn is planted. Some farmers plant corn on this soil for several successive seasons. Oats frequently lodge, especially in very wet seasons. Under the same management practices crop yields are higher than on any other soil in these two counties. Corn yields 45 to 50 bushels of grain or 15 tons of silage, oats 45 to 50 bushels of grain or 2 to 3 tons of hay, and timothy and clover hay 2 to 2½ tons an acre. Some alfalfa, potatoes, and garden vegetables are grown on this type of soil in other parts of the Connecticut Valley, but only a very small acreage is used for these crops in this area.

The areas used as pasture land furnish excellent grazing, and 2 acres of pasture can support one cow. Many of the narrow depressions in the areas used as pasture are swales or swamps, and these support a rank growth of weeds and rushes that furnish little grazing. Kentucky bluegrass is the most common pasture grass, but

witchgrass is present in most pastures and is a serious pest in many cultivated fields.

Hadley very fine sandy loam can be plowed safely in the fall, and it warms quickly in the spring. Its only disadvantage is that it is subject to occasional overflow, and when the water recedes, a deposit of fine sand, a foot or more thick, may be left in some places.

Hadley very fine sandy loam, low-bottom phase.—This soil closely resembles typical Hadley very fine sandy loam, but it lies at a lower level adjacent to the river and is overflowed frequently. In most places the surface soil is very dark brown and the subsoil layers are less yellow than corresponding layers in the typical soil. In many places deposits of very fine sand are on the surface. This soil is associated with the typical soil and covers a total area of only 0.4 square mile.

Practically all of this soil is used as pasture because the flood hazard is great, but a few acres are planted to corn or are used as hayfields. No manure or commercial fertilizer is applied.

Hadley loamy fine sand, low-bottom phase.—This soil resembles Hadley very fine sandy loam in color, but the surface soil is somewhat lighter brown. The surface soil and the subsoil are loose loamy fine sand, and the substratum consists of fine sand. The reaction is medium to strongly acid throughout. This soil occurs in small areas on natural levees along the edge of the bottom or where previous floods left a deep deposit of fine sand. The total area is only 0.9 square mile.

Most of the areas of this soil are cultivated as part of a field of Hadley very fine sandy loam, and they receive similar fertilization. Yields are lower, however, and crops are subject to damage from drought. Many areas are included in pastures, and some are forested.

Podunk-Rumney fine sandy loams.—Areas mapped as Podunk-Rumney fine sandy loams consist of a complex of intermingled areas of Podunk and Rumney fine sandy loams.

The 8- to 10-inch surface soil of Podunk fine sandy loam is very dark-gray or dusky-brown friable fine sandy loam. The subsoil is grayish-yellow friable fine sandy loam, more or less mottled with brown and rust brown, and extends to a depth of about 15 to 20 inches. Throughout the surface soil and subsoil no structure is apparent. The substrata comprise stratified gray sand, fine sand, and some silt that in most places are mottled with grayish yellow and rust brown and in many places contain soft rust-brown concretions. In general, the reaction is very strongly acid, the pH value being about 5.0, but in a few places the substrata are strongly to medium acid.

Rumney fine sandy loam has a profile similar to that of Podunk fine sandy loam, except that the surface soil is somewhat darker and in places is slightly mucky and the subsoil is more gray and less yellow. These characteristics reflect the poorer natural drainage of the Rumney soil.

Included with this soil complex in mapping are some areas having a sandy loam texture.

This soil complex occurs on the flood plains of the smaller streams and is well distributed throughout the area. The total area is 7.4 square miles. Some areas of this soil complex are near the stream

bed; in the larger bottoms the areas are at the edge of the flood plains, where they join the terraces or uplands. Podunk-Rumney fine sandy loams are developed in nearly flat areas, from alluvial deposits derived principally from granitic rocks. The Podunk soil is imperfectly drained, and the Rumney soil is poorly drained. Both soils are subject to frequent and prolonged inundation.

Most areas are included in pastures, a few are in hayfields, and a few of the better drained or artificially drained ones are cultivated. Many of the areas included in pastures are grown up to alder, willow, and brier thickets, although some afford good grazing during dry weather. Sedges and bentgrass are the most common pasture plants. The mowings are largely sedges and redtop, and in some seasons the grasses are cut two or three times and yield a total of 2 to 3 tons an acre. Corn is the only cultivated crop grown, and it is cut for silage. The yields range from 10 to 15 tons an acre, except where the crop is damaged by floods. Little or no fertilizer is used.

Podunk-Rumney silt loams.—Areas mapped as Podunk-Rumney silt loams comprise a complex of Podunk and Rumney soils similar to the complex just described, except that the texture is silt loam.

The 8- to 10-inch surface soil of Podunk silt loam is dark-gray or dusky-brown mellow silt loam. The structure is soft crumb in most places, but in some places it is lacking. Extending to a depth of 20 inches, the subsoil is yellowish-gray plastic silt loam or silty clay loam mottled with dark gray and rust brown and having a crumb or fragmental structure. Light-gray stratified very fine sand, silt, and clay compose the substratum. Some layers of very fine sand are nearly white. The surface soil and subsoil are strongly acid, but in most places the substrata are medium acid.

The 8- to 10-inch surface soil of Rumney silt loam is dark gray mottled with rust brown. The subsoil is gray plastic silt loam or silty clay loam mottled with dark gray and rust brown. The substrata are similar to those underlying Podunk silt loam.

In some places a 1- or 2-inch layer of sand has been deposited during recent floods on the surface of both soils of this complex. Included with this complex are areas of a dark poorly drained soil that occupies depressions associated with the Hadley soils where the reaction is nearly neutral. Also included are a few areas of poorly drained bottom lands associated with Suffield silt loam. This latter inclusion has a very dark gray silt loam surface soil, 10 to 12 inches thick, and a bluish-gray clay loam or clay substratum. If areas of this soil were extensive or numerous they would be shown on the soil map as Saco silt loam.

With the exceptions of the inclusions noted, Podunk-Rumney silt loams have developed from alluvium derived from granitic rocks in wide nearly flat bottoms on the larger streams and in a few small areas on the smaller drainageways. Most of the larger areas are not subject to frequent overflow. The complex is well distributed over the counties and has a total area of 5.4 square miles. A large area is mapped in the vicinity of Keene.

Most of the smaller bodies are used as pasture land, but the larger ones are in mowings, and a small acreage is planted to corn. Sedges, rushes, timothy, and redtop are the most common plants in the hayfields. An average of about 2 tons of hay an acre is produced. Manure is used as a top dressing when it is available, and most of

the meadows are not plowed unless weeds become prevalent. Manure is put on the sod before plowing for corn, and from 300 to 500 pounds of superphosphate may be added when the corn is planted. Most of the corn is cut for silage, which yields from 12 to 15 tons an acre. Oats are planted only when used as a nurse crop, as they are liable to lodge. The most common plants in pastures are sedges, rushes, and bentgrass, and many pastures are grown up with alder, willow, briers, and rushes.

The cultivated areas and those used as mowings are drained by open ditches.

SOILS WITH COARSE-TEXTURED SUBSTRATA

The only representatives of the group of soils with coarse-textured substrata are members of the Ondawa series and Alluvial soils, undifferentiated. The Ondawa soils occur on the flood plains of streams draining soils derived from granitic sources. They have brown surface soils, grayish-yellow subsoils, and gray or grayish-yellow sandy or gravelly stratified substrata. Ondawa fine sandy loam and its high-bottom phase and Ondawa loamy fine sand are mapped.

Ondawa fine sandy loam.—The 6- to 10-inch surface soil consists of brown or grayish-brown mellow fine sandy loam without definite structure. The subsoil, extending to a depth of 15 to 25 inches, is brownish-yellow mellow fine sandy loam or loamy fine sand without well-defined structure. Gray or grayish-yellow loose sand and gravel, or in some places loamy sand, make up the substratum. The reaction is strongly acid to medium acid throughout. Included with this soil in mapping are several areas in the vicinity of Keene where the texture of the surface soil and subsoil is loam. Some widely scattered areas, in which the texture is very fine sandy loam and others in which it is sandy loam, are also included. In some places the lower part of the subsoil is faintly mottled.

This soil occurs in first-bottom positions along all the streams except the Connecticut River. Some areas occur in the Connecticut Valley where the larger tributaries join the main river. The soil has a total area of 9.9 square miles.

Although it occurs on nearly flat river bottoms, this soil is well drained because it is open and porous and water passes through it quickly. It lies just above the normal level of the streams, and most areas are flooded one or more times each year.

Many areas of this soil are cultivated, and practically all of the others are used as pasture. Only the very narrow bottoms or those in isolated districts are forested. Corn and hay are the most common crops. Oats have a tendency to lodge. Manure applied to sod before plowing for corn is sometimes the only amendment used; but most farmers add 300 to 500 pounds of superphosphate when planting corn. Most of the corn is cut for silage, and the average yield is 12 to 15 tons an acre. Generally hay meadows are allowed to stand for several seasons, and many are top-dressed with manure after the second crop has been cut. Timothy and redtop are the common grasses, but many meadows contain much witchgrass. Bentgrass, Kentucky bluegrass, and witchgrass are the most common grasses in pastures. In most pastures there are many small and some large trees, but the pastures are comparatively free from weeds and other pests. They furnish good grazing, and usually 2 acres

furnish sufficient pasturage to support one cow. Red maple, hemlock, aspen, and gray birch are the chief trees in the forested areas.

As mapped, Ondawa fine sandy loam includes about one-half of a square mile of soil that contains 10 percent or more of gravel in the surface soil and subsoil. Most of this inclusion is used as pasture, as it occurs near the stream, where the coarser debris is deposited during each flood; but some areas containing small pieces of gravel are cultivated in the same manner as the typical soil.

Ondawa fine sandy loam, high-bottom phase.—This soil closely resembles typical Ondawa fine sandy loam but lies at a higher level and is not subject to overflow except during periods of very high water. The subsoil is decidedly browner than that of typical Ondawa fine sandy loam, and in many places it resembles the subsoil of Merrimac fine sandy loam. Small areas of this soil, totaling 3.1 square miles, are scattered over the area, except in the Connecticut Valley. In many places the soil is mapped along the smaller, swiftly flowing streams where the slope is about 5 percent. It is porous and well drained, so that water passes through it very quickly; but in most seasons the water table stands near enough to the surface to provide a constant supply of moisture for optimum growth of plants. Many small bodies of this soil are used as sites for homes and gardens. Where the soil occurs in large areas it is farmed in the same manner as typical Ondawa fine sandy loam. Oats are grown successfully and yield 30 and 40 bushels an acre without additional fertilization.

As mapped, this soil includes a small area of made land in Winchester village. The area has been filled in with sand and gravel and is used as a mill site. The material has no soil profile.

Ondawa loamy fine sand.—This soil resembles Ondawa fine sandy loam but is much looser. The 8- or 9-inch surface soil is weak-brown loose loamy fine sand without definite structure, and the subsoil, which extends to a depth of 24 to 30 inches, is yellowish-brown loose loamy fine sand, also without definite structure. In some places the upper part of the layer is rather bright yellowish brown. The substratum is grayish-yellow or gray loose fine sand or sand. The reaction is strongly to medium acid throughout. In some places this soil lies slightly above the level of normal overflow, and in a few places there is some gravel in the soil and substratum.

In many places Ondawa loamy fine sand occurs near stream channels and forms natural levees. It is most extensive along the Ashuelot River in the vicinity of Keene and West Swanzey. It has a total area of 3.1 square miles. The land is nearly flat to billowy.

Most areas of this soil are included in pastures, as it is not so productive as Ondawa fine sandy loam. Bentgrass, Kentucky bluegrass, and witchgrass are the most common pasture grasses, and 3 acres provide sufficient feed for a cow in most pastures. A few acres are cultivated as part of a field made up largely of some other soil. Very few areas are forested, but willow, white pine, and red maple trees grow in some pastures.

Alluvial soils, undifferentiated.—In most places these soils are very poorly drained first bottoms along small streams, but in some places stony or very gravelly areas along the larger streams are included. The surface soil in most places is very dark-gray mucky sandy loam or fine sandy loam mottled with rust brown. The sub-

stratum is gray or mottled gray, brown, and rust-brown sand or gravel. South of North Walpole a series of rock outcrops along the Connecticut River have been included in this land type. In some places areas of loose stones and gravel, sometimes classified as riverwash, are included.

This class of material occurs in small bodies in all parts of the area. It has a total area of 24.3 square miles.

Soil areas fitting this description are never cultivated, but those included in farms are used as pasture, and the isolated areas are forested.

Sedges are the most common plants in the pastured areas. They furnish good grazing during dry weather, but the ground is soft in spring and fall. In forested areas, the chief plants are alder, briers, red maple, hemlock, and some willow.

ORGANIC SOILS

The organic soils are Muck; Muck, shallow phase; Peat; and Peat, shallow phase.

Muck.—Muck consists of very dark-brown or black well-decomposed organic matter containing some mineral material. The plant remains have disintegrated to the point that individual fibers and cell structure cannot be separated and used to identify the original plants. In most places this material extends to a depth of 3 feet or more, and in some places the lower part is brown fibrous organic matter and the substratum is gray or bluish-gray till or sand and gravel.

Muck occurs in depressions and in very flat areas along stream channels. Bodies totaling 2.9 square miles are widely scattered over the two counties.

A few areas of Muck are used as pasture, and some as wild-hay meadows, but most areas are forested. Sedges predominate in the pastures and mowings, and the forested areas support a dense growth of alder, briers, red maple, willow, and some hemlock.

Muck, shallow phase.—The shallow phase of Muck is mapped where the deposit of organic material is less than 3 feet deep. It is similar to Muck in other characteristics. Small bodies, totaling 0.3 square mile, are widely scattered over Sullivan County.

Peat.—Peat occurs where organic matter has accumulated on areas sufficiently wet to preserve some of the cell structure and plant forms. In most places the accumulation is more than 3 feet thick. It consists of brown or dark-brown partly decomposed remains of algae, sedges, ferns, grasses, shrubs, and trees. Many large areas occupy depressions in the uplands and on the terraces of all parts of the area, and a few are on the flood plains of streams. They aggregate 39.3 square miles.

Most of the areas are forested, but a few are included in pastures. The growth in forested areas consists of red maple, spruce, alder, briers, hemlock, and eastern larch, or tamarack (*Larix laricina* (DuRoi) K. Koch). Sedges grow in the pastures, but they furnish little grazing, as most areas of Peat are very soft except in dry seasons.

Peat, shallow phase.—The shallow phase of Peat, mapped where the accumulation of organic matter is less than 3 feet thick, occurs in small areas or around the edges of the larger areas of typical Peat. It has a total area of only 0.3 square mile.

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ROUGH STONY LANDS

Most of the areas designated as rough stony land contain boulders too large to be moved by a two-horse team, so that it is impracticable or impossible to prepare the land for cultivation with machinery. Others have a slope steeper than 30 percent or include large stone outcrops or ledges. Some of the land now classified as rough stony land was farmed at one time with hand implements. At present most of it is forested, but some areas are used as pasture. Much of the land is isolated from settled districts, and very few roads are maintained through such areas. These areas were mapped in reconnaissance and include many small tillable areas. Many small areas of poorly and imperfectly drained soils are also included. As all of the soil materials included in these separations have been described in the foregoing pages, descriptions of them are not repeated.

The pastured areas of rough stony land furnish very poor grazing because in some places as much as 30 to 40 percent of them is covered by stone fragments and from 50 to 90 percent of the rest is covered by hardhack, juniper, ferns, briers, trees, or other growth that decreases the grazing area.

Rough stony land (Hollis soil material).—This land, covering a total area of 81.6 square miles, includes areas in which the soil material between the rocks has the characteristics of members of the Hollis series. In places inclusions are made in which the soil material belongs to the Charlton series. The largest bodies are in the northern and western parts of the area.

Rough stony land (Gloucester soil material).—A total area of 77.2 square miles of this land is mapped. It is scattered throughout the area.

Rough stony land (Marlow soil material).—A total area of 33.7 square miles is mapped under this designation, which also includes bodies that would be mapped as shallow phases if the areas were larger. This land occurs only in Cheshire County, chiefly in the northeastern part.

Rough stony land (Brookfield soil material).—Like the land type just mentioned, this land type includes bodies that would be mapped as shallow phases if their size warranted the separation. The total area is 37.4 square miles, most of which occurs in the east-central part of the area.

Rough stony land (Essex soil material).—Only 6 square miles of this land type is mapped. The largest areas are in the northeastern corner of Cheshire County, but a few small areas are scattered throughout Sullivan County.

Rough stony land (Shapleigh soil material).—A total area of 102.5 square miles of this land is mapped, mainly in the southwestern part of the area.

Rough stony land (Hermon soil material).—Extensive bodies of this land type occur in the northeastern and eastern parts of Sullivan County. The total area is 25.5 square miles.

Rough stony land (Canaan soil material).—This is one of the most inextensive types of rough stony land. A total area of 9.9 square miles is mapped, mainly in the eastern part of the area.

Rock outcrop. Very large ledges and nearly bare rock outcrops are shown on the soil map. Scattered areas are in all parts of both counties, but the largest area occupies the top of Monadnock Mountain. Most areas support no vegetation, but a few have a sparse growth of scrubby spruce.

GRAVEL PITS

Many gravel pits are scattered over both counties, and those large enough to be outlined are shown on the soil map. Smaller gravel pits and stone quarries are shown by special symbols. These pits have no agricultural use, but are valuable as a source of sand and gravel for commercial and private use. In some places the excavated material is mixed directly with portland cement for making concrete.

PRODUCTIVITY RATINGS

In table 7 the soils of Cheshire and Sullivan Counties are listed alphabetically and estimated average acre yields of the principal crops are given for each soil under the prevailing farming practices.

TABLE 7.—*Estimated acre yields of the most important crops grown on the soils of Cheshire and Sullivan Counties, N. H., under prevailing farm practices* [1]

Soil	Corn (grain)		Corn (silage)		Oats (grain)		Oats (hay)		Mixed hay		Potatoes		Pasture
	A	B	A	B	A	B	A	B	A	B	A	B	A
	Bu.	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Acres per cow per season*
Adams loamy fine sand	15	25	4	6	15	25	0.75	1.5	0.5	1.5	---	---	[2] 9
Agawam fine sandy loam	35	60	10	16	40	---	2.0	---	1.5	3.0	200	350	2
Agawam loamy fine sand	20	35	4	8	25	35	1.0	1.5	.5	1.5	---	---	4
Agawam loamy fine sand, broken phase	---	---	---	---	---	---	---	---	---	---	---	---	6
Agawam very fine sandy loam	35	60	10	16	40	---	2.0	---	1.5	3.0	200	350	2
Alluvial soils, undifferentiated	---	---	---	---	---	---	---	---	---	---	---	---	[3] 2
Blandford loam	---		5	8	30		1.5	-	.75	3.0	150	300	2
Brookfield loam	25	40	5	8	20	25	1.0	2.0	.5	1.5	100	200	6
Brookfield stony loam	---	---	---	---	---	---	---	---	---	---	---	---	6
Brookfield stony loam, shallow phase	---	---	---	---	---		---	---	.5	1.0		---	7
Brookfield stony loam, steep phase	---	---	---	---	---	---	---	---	---	---	---	---	7
Canaan stony sandy loam	---	---	---	---	---	---	---	---	---	---	---	---	6
Charlton loam	40	60	12	16	40	---	2.0	---	1.5	3.0	200	350	---
Charlton loam, steep phase	40	55	10	14	40	---	1.5	---	2.0	3.0	200	300	3
Charlton stony loam	---	---	---	---	---	---	---	---	---	---	---	---	3
Charlton stony loam, steep phase	---	---	---	---	---	---	---	---	---	---	---	---	3
Colton gravelly sandy loam	20	30	5	8	20	30	.75	1.5	.5	1.5	---	---	[2] 5
Colton loamy sand	15	25	4	6	15	25	.75	1.5	.5	1.5	---	---	[2] 6
Colton sandy loam	20	30	5	8	20	30	1.0	1.5	.75	1.5	---	---	[2] 5
Danby gravelly fine sandy loam	15	25	3	5	15	20	.5	1.5	.5	1.5	-		[2] 8
Danby gravelly sandy loam	15	20	3	5	15	20	.5	1.5	.5	1.5	---	---	[2] 8
Danby loamy sand	---	---	---	---	---	---	---	---	---	---	---	---	[2] 9
Essex loam	35	50	10	14	30	---	---	2.0	.75	3.0	150	300	3
Essex stony loam	---	---	-	---	---	---	---	---	---	---	---	---	3
Essex stony loam, steep phase	---	---	-	-	---	---	---	---	---	---	---	---	4
Gloucester fine sandy loam	25	35	5	8	20	30	1.0	2.0	.5	1.5	100	200	5
Gloucester stony fine sandy loam	---	---	---	---	---	---	---	---	---	---	---	---	5
Gloucester stony fine sandy loam, steep phase	---	---	---	---	---	-	---	---	---	---	---	---	5
Hadley loamy fine sand, low-bottom phase	30	45	10	12	35	40	1.5	2.0	1.0	2.0	---	---	2
Hadley very fine sandy loam	50	---	15	---	45	---	2.0	---	2.5	---	---	---	1.5
Hadley very fine sandy loam, low-bottom phase	50	---	15	---	---	---	---	---	2.5	---	---	---	1.5
Hartland very fine sandy loam	---	---	---	---	---	---	---	---	.75	2.0	---	---	3
Hartland very fine sandy loam, broken phase	---	---	---	---	---	---	---	---	---	---	---	---	---
Hermon stony sandy loam	---	---	---	---	---	---	---	---	---	---	---	---	
Hermon stony sandy loam, steep phase	---	---	---	---	---	---	---	---	---	---	---	---	

See footnotes at end of table.

Table 7.—*Estimated acre yields of the most important crops grown on the soils of Cheshire and Sullivan Counties, N. H., under prevailing farm practices* [1]—Con.

Soil	Corn (grain) A	Corn (grain) B	Corn (silage) A	Corn (silage) B	Oats (grain) A	Oats (grain) B	Oats (hay) A	Oats (hay) B	Mixed hay A	Mixed hay B	Potatoes A	Potatoes B	Pasture A
	Bu.	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Acres per cow per season*
Hinckley gravelly fine sandy loam	15	25	3	5	15	20	0.5	1.5	0.5	[4] 2			[2] 8
Hinckley loamy sand													[2] 9
Hollis loam	40	60	12	16	40		2.0		1.5	3.0	100	200	2
Hollis loam, steep phase	25	35	7	10	35		1.5		.75	2.0	100	200	2
Hollis stony loam													3
Hollis stony loam, steep phase													4
Jaffrey gravelly sandy loam	15	25	3	5	15	20	.5	1.5	.5	1.5			[2] 8
Marlow loam	35	50	10	14	35		1.5		1.0	3.0	200	350	2
Marlow stony loam													2
Marlow stony loam, steep phase													4
Melrose fine sandy loam	40	60	10	16	25	35	2.0	3.0	1.0	2.5			2
Merrimac fine sandy loam	25	40	6	9	25	35	1.0	1.5	.75	1.5			[2] 5
Merrimac gravelly fine sandy loam	25	35	5	8	25	35	1.0	1.5	.75	1.5			[2] 5
Merrimac gravelly loamy sand	20	30	4	6	20	30	.75	1.5	.5	1.5			[2] 6
Merrimac gravelly loamy sand, broken phase													[2] 9
Merrimac loamy sand	15	25	4	6	20	30	.75	1.5	.5	1.5			[2] 8
Muck									[5] 3.0				[3] 2
Muck, shallow phase									[5] 2.0				[3] 2
Ondawa fine sandy loam	40	60	12	16			2.0		1.5	2.5			3
Ondawa fine sandy loam, high-bottom phase	40	60	12	16	30	40	2.0	3.0	1.5	2.5			3
Ondawa loamy fine sand	25	35	6	8	25	30	.75	1.5	1.0	2.0			3
Peat									[5] 3.0				
Peat, shallow phase									[5] 2.0				[3] 2
Peru stony loam									.75	2.0			[3] 2
Podunk-Rumney fine sandy loams			12						[5] 2.0				[3] 2
Podunk-Rumney silt loams			10	15					[5] 2.0				[3] 2
Rock outcrop													
Rough stony land (Brookfield soil material)													14
Rough stony land (Canaan soil material)													12
Rough stony land (Essex soil material)													8
Rough stony land (Gloucester soil material)													10
Rough stony land (Hermon soil material)													10
Rough stony land (Hollis soil material)													8
Rough stony land (Marlow soil material)													9
Rough stony land (Shapleigh soil material)													12
Shapleigh sandy loam									.5	1.5			6
Shapleigh stony sandy loam													6
Shapleigh stony sandy loam, steep phase													6
Sudbury fine sandy loam	25	35	7	9	25	35	1.0	1.5	.75	2.5			3
Suffield silt loam	40	60	12	16	35		1.5		20.0	3.0			3
Sutton silt loam			11	15	35		1.5		1.0	3.0			3
Whitman stony loam									.75				[3] 3
Windsor loamy fine sand													[2] 6
Windsor loamy fine sand, eroded phase													
Woodbridge loam	35	50	10	14	35		2.0		1.0	3.0	200	300	3
Woodbridge loam, steep phase													3
Woodbridge stony loam													3
Woodbridge stony loam, steep phase													4

[1] Yields in the columns headed A are commonly obtained without the use of amendments, such as mixed fertilizers, but include lime or heavy applications of manures; those in the columns headed B are commonly obtained with the use of superphosphate or mixed fertilizers, and manure. The more common fertilizing practices are to apply manure and 300 to 500 pounds of superphosphate or 4–12–4 on cornland, and 1,000 pounds of 10–16–14 or 8–16–16 or 1,500 to 2,000 pounds of 5–8–7 or 4–6–10 to land used for growing potatoes. The yields of hay given are those obtained with the use of manure during the first 2 years. Lime is not commonly applied. Where no yields are given the crop is not commonly grown.

[2] Pastures fail during periods of drought.

[3] Pastures cannot be grazed during very wet periods.

[4] Some alfalfa is grown.

[5] Wild grasses are included.

The estimates in table 7 are based primarily on interviews with farmers, the county agricultural agent, members of the staffs of the University of New Hampshire Agricultural Experiment Station and College of Agriculture, and other persons who have had experience in the agriculture of these counties. As such, they are presented as estimates of the average production over a period of years according to the prevailing type of farming. It is realized that these estimates may not apply directly to specific tracts of land for any particular year: The soils as shown on the map vary somewhat from place to place, management practices differ slightly from farm to farm, and climatic conditions fluctuate from year to year. On the other hand these estimates appear to be as accurate information as can be obtained without further detailed and lengthy investigations, and they serve to bring out the relative productivity of the soils shown on the map.

In order to compare directly the yields obtained in Cheshire and Sullivan Counties with those obtained in other parts of the United States, yield figures have been converted in table 8 to indexes based on standard yields. The indexes are computed to the nearest 5 percent, except for pasture. The soils are listed in the approximate order of their general productivity under the practices indicated in column B, beginning with the most productive.

The rating compares the productivity of each of the soils for each crop to a standard of 100. This standard index represents the approximate average acre yield obtained without the use of amendments on the more extensive and better soil types of the regions of the United States in which the crop is most widely grown. An index of 50 indicates that the soil is about half as productive for the specified crop as is the soil with the standard index. The standard yield for each crop shown in table 8 is given at the head of each respective column. Soils given amendments, such as lime and commercial fertilizers, or special practices, such as irrigation, and unusually productive soils of small extent, may have productivity indexes of more than 100 for some crops.

The principal factors affecting the productivity of land are climate, soil (including the many physical, chemical, and biological characteristics), slope, drainage, and management (including the use of amendments). No one of these factors operates separately from the others, although some one may dominate. In fact, the factors listed may be grouped simply as the soil factor and the management factor. Slope, drainage, and most of the aspects of climate may be considered characteristics of a given soil type, since the soil type, as such, occupies specific geographical areas characterized by a given range of slope and climatic conditions. Yields of crops over a long period of years furnish the best available summation of the associated factors, and therefore they are used where available.

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TABLE 8.—*Productivity ratings of the soils in Cheshire and Sullivan Co*

Soil [1]	Crop productivity index [2] for—													General produc ity (B practic	
	Corn				Oats				Mixed hay (100=2 tons)		Potatoes (100=200 bu.)		Pasture (100=100 cow-acre-days) [3]	Grade number [4]	Grou
	Grain (100=50 bu.)		Silage (100=12 tons)		Grain (100=50 bu.)		Hay (100=2 tons)								
	A	B	A	B	A	B	A	B	A	B	A	B	A		
Hadley very fine sandy loam	100	----	125	----	90	----	100	----	125	----	----	----	100	1+	Very I
Agawam very fine sandy loam	70	120	85	135	80	----	100	----	75	150	100	175	75	1+	
Agawam fine sandy loam	70	120	85	135	80	----	100	----	75	150	100	175	75	1+	
Ondawa fine sandy loam, high-bottom phase.	80	120	100	135	60	80	100	150	75	125	----	----	50	1+	
Ondawa fine sandy loam	80	120	100	135		----	100	----	75	125		----	50	1+	
Charlton loam	80	120	100	135	80	----	100	----	75	150	100	175	----	1+	
Melrose fine sandy loam	80	120	85	135	50	70	100	150	50	125	----	----	75	1	
Hollis loam	60	80	65	100	80	----	75	----	40	100	50	100	75	1+	
Hadley very fine sandy loam, low-bottom phase.	100	----	125	----	----	----	----	----	125	----	----	----	100	1	
Hadley loamy fine sand, low-bottom phase.	60	90	85	100	70	80	75	100	50	100	----	----	75	1	
Sutton silt loam	----	----	90	125	70	----	75	----	50	150	----	----	50	1	
Marlow loam	70	100	85	115	70	----	75	----	50	150	100	175	50	1	
Charlton loam, steep phase	80	110	85	115	80	----	75	----	75	150	100	150	50	1	
Woodbridge loam	70	100	85	115	70	----	100	----	50	150	100	150	50	1	
Suffield silt loam	80	120	100	135	70	----	75	----	100	150	----	----	50	1	
Blandford loam	----	----	40	65	60	----	75	----	40	150	75	150	75	2	
Essex loam	70	100	85	115	60	----	100	----	40	150	85	150	75	2	

Hollis loam, steep phase	50	70	60	85	70	--	75	--	40	100	50	100	75	2	
Ondawa loamy fine sand	50	70	50	65	50	60	40	75	50	100	--	--	50	3	High
Agawam loamy fine sand	40	70	35	65	50	70	50	75	25	75	--	--	38	3	
Merrimac fine sandy loam	50	80	50	75	50	70	50	75	40	75	--	--	[5] 30	3	
Merrimac gravelly fine sandy loam.	50	70	40	65	50	70	50	75	40	75	--	--	[5] 30	3	
Brookfield loam	50	80	40	65	40	50	50	100	25	75	50	100	25	3	
Sudbury fine sandy loam	50	70	60	75	50	70	50	75	40	125	--	--	50	3	
Colton sandy loam	40	60	40	65	40	60	50	75	40	75	--	--	[5] 30	4	
Gloucester fine sandy loam	50	70	40	65	40	60	50	100	25	75	50	100	30	4	
Colton gravelly sandy loam	40	60	40	65	40	60	40	75	25	75	--	--	[5] 30	4	
Merrimac gravelly loamy sand	40	60	35	50	40	60	40	75	25	75	--	--	[5] 25	4	
Merrimac loamy sand	30	50	35	50	40	60	40	75	25	75	--	--	[5] 19	4	
Adams loamy fine sand	30	50	35	50	30	50	40	75	25	75	--	--	[5] 17	5	Medi
Hinckley gravelly fine sandy loam.	30	50	25	40	30	40	25	75	25	[6] 100	--	--	[5] 19	5	
Colton loamy sand	30	50	35	50	30	50	40	75	25	75	--	--	[5] 25	5	
Jaffrey gravelly sandy loam	30	50	25	40	30	40	25	75	25	75	--	--	[5] 19	5	
Danby gravelly fine sandy loam	30	50	25	40	30	40	25	75	25	75	--	--	[5] 19	5	
Danby gravelly sandy loam	30	40	25	40	30	40	25	75	25	75	--	--	[5] 19	5	
Podunk-Rumney fine sandy loams.	--	--	100	--	--	--		--	[7] 100	--	--	--	[8] 75	6	
Podunk-Rumney silt loams	--	--	85	125	--	--	--	--	[7] 100	--	--	--	[8] 75	6	
Muck	--	--	--	--	--	--	--	--	[7] 150	--	--	--	[8] 75	6	
Peat	--	--	--	--	--	--	--	--	[7] 150	--	--	--	[8] 75	6	Medi to l
Muck, shallow phase	--	--	--	--	--	--	--	--	[7] 100	--	--	--	[8] 75	6	
Peat, shallow phase	--	--	--	--	--	--	--	--	[7] 100	--	--	--	[8] 75	6	
Hartland very fine sandy loam	--	--	--	--	--	--	--	--	40	100	--	--	50	6	
Peru stony loam	--	--	--	--	--	--	--	--	40	100	--	--	[8] 75	6	
Whitman stony loam	--	--	--	--	--	--	--	--	40	100	--	--	[8] 50	6	
Shapleigh sandy loam	--	--	--	--	--	--	--	--	25	75	--	--	25	7	
Brookfield stony loam, shallow phase.	--	--	--	--	--	--	--	--	25	50	--	--	21	7	

See footnotes at end of table.

TABLE 8.—*Productivity ratings of the soils in Cheshire and Sullivan Counties,*

Soil [1]	Crop productivity index [2] for—													General produ ity (B practic	
	Corn				Oats				Mixed hay (100=2 tons)		Potatoes (100=200 bu.)		Pasture (100=100 cow-acre-days) [3]	Grade number [4]	Gro
	Grain (100=50 bu.)		Silage (100=12 tons)		Grain (100=50 bu.)		Hay (100=2 tons)								
	A	B	A	B	A	B	A	B	A	B	A	B	A		
Alluvial soils, undifferentiated	—	—	—	—	—	—	—	—	—	—	—	—	[8] 75	8	Low.
Charlton stony loam	—	—	—	—	—	—	—	—	—	—	—	—	50	8	
Hollis stony loam	—	—	—	—	—	—	—	—	—	—	—	—	50	8	
Marlow stony loam	—	—	—	—	—	—	—	—	—	—	—	—	50	8	
Woodbridge loam, steep phase	—	—	—	—	—	—	—	—	—	—	—	—	50	8	
Woodbridge stony loam	—	—	—	—	—	—	—	—	—	—	—	—	50	8	
Charlton stony loam, steep phase.	—	—	—	—	—	—	—	—	—	—	—	—	50	9	
Essex stony loam	—	—	—	—	—	—	—	—	—	—	—	—	38	9	
Hollis stony loam, steep phase	—	—	—	—	—	—	—	—	—	—	—	—	38	9	
Woodbridge stony loam, steep phase.	—	—	—	—	—	—	—	—	—	—	—	—	38	9	
Essex stony loam, steep phase	—	—	—	—	—	—	—	—	—	—	—	—	38	9	
Marlow stony loam, steep phase	—	—	—	—	—	—	—	—	—	—	—	—	38	9	
Gloucester stony fine sandy loam	—	—	—	—	—	—	—	—	—	—	—	—	30	10	
Gloucester stony fine sandy loam, steep phase.	—	—	—	—	—	—	—	—	—	—	—	—	30	10	
Hermon stony sandy loam	—	—	—	—	—	—	—	—	—	—	—	—	30	10	
Hermon stony sandy loam, steep phase.	—	—	—	—	—	—	—	—	—	—	—	—	30	10	
Windsor loamy fine sand	—	—	—	—	—	—	—	—	—	—	—	—	25	10	
Agawam loamy fine sand, broken phase.	—	—	—	—	—	—	—	—	—	—	—	—	25	10	
Brookfield stony loam	—	—	—	—	—	—	—	—	—	—	—	—	25	10	
Canaan stony sandy loam	—	—	—	—	—	—	—	—	—	—	—	—	25	10	
Shapleigh stony sandy loam	—	—	—	—	—	—	—	—	—	—	—	—	25	10	

Shapleigh stony sandy loam, steep phase.	-	-	-	-	-	-	-	-	-	-	-	-	25	10	Very
Brookfield stony loam, steep phase.	-	-	-	-	-	-	-		-	-	-	-	21	10	
Rough stony land (Essex soil material).	-	-	-	-	-	-	-	-	-	-	-	-	19	10	
Rough stony land (Hollis soil material).	-	-	-	-	-	-	-	-	-	-	-	-	19	10	
Danby loamy sand	-	-	-	-		-	-	-	-	-	-	-	[5] 17	10	
Hinckley loamy sand	-	-	-	-	-	-	-	-	-	-	-	-	[5] 17	10	
Merrimac gravelly loamy sand, broken phase.	-	-	-	-	-	-	-	-	-	-	-	-	[5] 17	10	
Rough stony land (Marlow soil material).	-	-	-	-	-	-	-	-	-	-	-	-	17	10	
Rough stony land (Gloucester soil material).	-	-	-	-	-	-	-	-	-	-	-	-	15	10	
Rough stony land (Hermon soil material).	-	-	-	-	-	-	-	-	-	-	-	-	15	10	
Rough stony land (Canaan soil material).	-	-	-	-	-	-	-	-	-	-	-	-	12	10	
Rough stony land (Shapleigh soil material).	-	-	-	-	-	-	-	-	-	-	-		12	10	
Rough stony land (Brookfield soil material).	-	-	-		-	-	-	-	-	-	-	-	10	10	
Hartland very fine sandy loam, broken phase.	-	-	-	-	-	-	-	-	-	-	-	-		-	
Windsor loamy fine sand, eroded phase.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Rock outcrop	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

[1] The soils are listed in the approximate order of their general productivity under common practices of improved soil mana

[2] The soils are given indexes that indicate the approximate average production of each crop in percentage of the standard o average acre yield obtained without the use of amendments on the more extensive and better soil types of the regions in the U The indexes are based on estimates of yields (see table 7), as yield data are too fragmentary to be adequate. Yields have be indexes are given if the crop is not commonly grown. The indexes in the column headed A under each crop refer to yields ob fertilizers or lime, but include heavy applications of manure; the indexes in column B refer to yields obtained with the use of s and potatoes; manure is applied to corn and hay. Lime is not commonly applied, and the indexes for hay refer to the yield du

[3] The term "cow-acre-days" is used to express the carrying capacity of pasture land. It represents the number of days t injury to the pasture, or the product of the number of animal units to the acre multiplied by the number of days of grazing. The ments of livestock. It is the equivalent of a mature cow, steer, or horse, or of 5 hogs, or 7 sheep or goats. For example, a soil to the acre for 100 days of the year, or for 2 cows or 2 animal units for 50 days, would rate 100 cow-acre-days; and another soil to 2 acres for 150 days would rate 75 cow-acre-days. These indexes are based on a grazing season of 150 days. Refer to table 7 f

[4] The grade numbers indicate the general productivity of the soils for the common crops. Refer to the text for further expl

[5] Pastures fail during periods of drought.

[6] Some alfalfa is grown.

[7] Wild grasses are included.

[8] Pastures cannot be grazed during very wet periods.

General productivity grade numbers are assigned in the column "General productivity grade number." The general productivity grade is usually based on a weighted average of the indexes for the various crops, the weighting depending on the relative acreage and value of the crops. If the weighted average is between 90 and 100, the soil type is given a grade of 1; if it is between 80 and 90, a grade of 2 is given; and so on.[8] Since it is difficult to measure mathematically either the exact significance of a crop in the agriculture of an area or the importance or suitability of certain soils for particular crops, perhaps too much significance may be given to the order in which the soils are listed. On the other hand, the arrangement does give information as to general productivity, and descriptive terms have been given.

Productivity tables do not present the relative roles that soil types, because of their extent and the pattern of their distribution, play in the agriculture of the county. The tables show the relative productivity of individual soils. They cannot picture in a given county the total quantitative production of crops by soil areas without the additional knowledge of the acreage of the individual soil types devoted to each of the specified crops.

Economic considerations play no part in determining the crop productivity indexes. These indexes cannot be interpreted, therefore, into land values except in a very general way. Distance to market, relative prices of farm products, and other factors influence the value of land. It is important to realize that productivity, as measured by yields, is not the only consideration that determines the relative worth of a soil for growing crops. The ease or difficulty of tillage and the ease or difficulty with which productivity is maintained are examples of considerations other than productivity that influence the general desirability of a soil for agricultural use. In turn, steepness of slope, presence or absence of stone, the resistance to tillage offered by the soil because of its consistence or structure, and the size and shape of areas are characteristics of soils that influence the relative ease with which they can be tilled. Likewise, inherent fertility and susceptibility to erosion are characteristics that influence the ease of maintaining soil productivity at a given level. Productivity, as measured by yields, is influenced in some degree by all these and other factors, such as moisture-holding capacity of the soil and its permeability to roots and water. Such factors should not be considered entirely separately from productivity; on the other hand, schemes of land classification to designate the relative suitability of land for agricultural use must give some separate recognition to them.

The table also gives information as to the principal crops grown on, or other use made of, each soil type. It is apparent that the desirability of some soils, such as Hollis loam, is influenced more by workability than by productivity.

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[8] Instead of following the usual procedure for weighting by percentages the indexes of the individual crops, the general productivity grade numbers in table 8 have been assigned from visual inspection of the indexes, based on an average of the indexes for corn silage, oats (grain), mixed hay, and potatoes. No precise mathematical calculations have been used.

LAND USES AND AGRICULTURAL METHODS

Under present economic conditions the soils in Cheshire and Sullivan Counties are being used to good advantage. If future demands for produce and livestock should arise and cause prices to increase, however, much more food could be produced and much more land could be profitably farmed. Much improvement should be made in pastures, as many areas, if they were cleared of hardhack, juniper, ferns, brush, and stumps, and if they were properly cultivated and fertilized, could support a cow to the acre.

Many farmers keep manure for 2 or 3 years before applying it to the soil. This practice allows many plant nutrients to be lost. The fears of the farmers that fresh manure is harmful have no foundation in fact.

Areas that are farmed intensively must be protected from erosion. One method of control planned by the Soil Conservation Service of the United States Department of Agriculture is demonstrated on a farm in Walpole.

A list of available publications giving experimental results and recommendations follows:

University of New Hampshire Agricultural Experiment Station Bulletins 217, Adjusting Farm Production in Cheshire County, N. H., to Market Demands; 222, Can New Hampshire Produce More of What She Eats; 260, An Economic Study of Dairy Farming in Grafton County, New Hampshire, 1930; 271, Fertilizer Experiments on "Run-Out" Hay Land; 275, Efficiency Studies in Dairy Farming; 279, Studies in Economics of Apple Orcharding; and 298, Land Utilization in New Hampshire: I. Problems in the Back Highland Areas of Southern Grafton County.

University of New Hampshire Agricultural Experiment Station Circulars 44, Liming New Hampshire Farm Lands; 47, Fertilizer Experiments with Sweet Clover; 48, Top Dressing Pasture Lands with Fertilizer; and 50, Fertilizer Experiments with Hay Crops in the Connecticut Valley.

New Hampshire University Extension Circular 50, A Successful Two-Man Farm.

More advanced information will be published from time to time, and persons wishing further information should communicate with the University of New Hampshire Agricultural Experiment Station, Durham, N. H., and with the county agricultural agents in Claremont and Keene.

MORPHOLOGY AND GENESIS OF SOILS

Soil is the product of the forces of weathering and development acting on the parent soil materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point depend on (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and has existed since accumulation; (3) the plant and animal life in and on the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of development have acted on the material. External climate, although important in its effects on soil development, is less so than internal soil climate, which depends not only on temperature, rainfall, and humidity, but on the physical characteristics of the soil or soil material and on the relief, which, in turn, strongly influences drainage, aeration, runoff, erosion, and exposure to sun and wind.

The soils in Sullivan and Cheshire Counties have developed from glacial drift, comparatively recent alluvial deposits, and organic accumulations. The area covered by alluvial deposits and organic accumulations is comparatively small, and separations of these materials or soils derived from them are not discussed in this section, as they are not the result of processes governing soil development in this general region.

Of the area covered by glacial drift, about 85 percent is covered by till and the rest by fluvial deposits such as kames, eskers, terraces, and lake plains. In about 60 or 70 percent of the area covered by glacial till—more than 50 percent of the entire area of the two counties—the till is composed largely of granitic debris and the rest largely of debris derived from schist rocks with a slight admixture of granite. In most places this till is dominantly of local origin and lies on or near rock formations similar to those from which it was derived.

This region originally was forested with hemlock, white pine, sugar maple, white birch, gray birch, yellow birch, ash, red oak, and chestnut [9] (*5, pp. 7–8*). As the rainfall was comparatively high, the land was forested, and the soil was frozen during several months of each year, evaporation was slight and much water percolated through the soil. These conditions promoted the accumulation of acid organic matter on the surface. In a virgin forest (preserved as a museum by Harvard University) on Mount Pisgah (*7*) north of Ashuelot village in the town of Winchester, this accumulation is 6 inches thick. In places where these conditions prevail, bases of the alkali and alkaline earth groups are leached from the entire soil profile. Iron and aluminum are largely leached from the surface soil, partly deposited in the subsoil as sesquioxides, and partly removed in the ground water. This process causes a relative concentration of silica in the surface soil, or A horizon, and of iron and aluminum in the subsoil, or B horizon. A large quantity of water that has become acid in the organic layer percolates through the soil, thereby leaching it and controlling the podzolization process of soil development. Where this process reaches its full expression, the soils are known as true Podzols (*10*).

True Podzols in these counties are characterized by a 3- to 5-inch layer of organic matter on the surface, a 2- or 3-inch gray or white sandy mineral surface soil (bleicherde), and about a 4-inch dark-brown or coffee-colored subsoil (orterde), which grades through yellowish brown and brownish yellow into the substratum or parent material of the soil. Soils having this description comprise about 50 square miles in Sullivan County, including Sunapee and Lovewell Mountains and the northeastern part of the county. In Cheshire County less than 10 square miles in the vicinity of Monadnock Mountain represent true Podzols.

If the soils in this area had been studied before the area was cleared or otherwise disturbed by man, it would have been learned that, in most well-drained places, the soils had thin horizons comparable to those characteristic of true Podzols. The podzolization process of soil development is retarded on dry, steep slopes, as much

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[9] All the chestnut trees have been killed by the oriental chestnut blight.

of the water runs off; but on gentler slopes most of the water is absorbed by the organic matter. The presence of bedrock or compact substrata near the surface of the soil acts in the same inhibiting manner as slope, since it causes the solum to become saturated with the addition of a comparatively small quantity of water, and additional precipitation runs off the surface. Podzolization is also impeded in areas where the soils are derived from schist, as water leaches slowly through fine-grained soils. Another factor affecting the expression of this process is elevation. At low elevations the average temperature is higher, which increases the rate of evaporation and tends to reduce the quantity of water percolating through the soil. High temperatures also act to hasten oxidization, so that organic matter accumulates more slowly. There are proportionately more hardwood trees than conifers at lower altitudes in Cheshire and Sullivan Counties, and most of the litter from many species of these trees is consumed by earthworms and microscopic insects (*6*). The litter from conifers is more acid than that from most broadleaved deciduous trees (*4*), and an acid reaction is necessary to peptize iron and aluminum colloids.

In most places in the area covered by this survey, one or more inhibiting factors are sufficiently active to prevent the development of true Podzol soil profiles. Some of the essential horizons are thin or entirely lacking. The average development of a profile in old forests consists of an organic mat about 3 inches thick, a bleicherde less than 2 inches thick—in many places only half an inch thick—and an orterde 2 or 3 inches thick. Soils having a very thin Podzol profile have recently been recognized as constituting a great soil group. This has been called the Brown Podzolic group of soils (*1*). Large parts of this area consist of members of this great soil group. In many places these horizons have been mixed by cultivating, pasturing, or lumbering; but traces of all horizons can be recognized in fence rows or at the edge of large boulders in areas of all zonal soils.

In about one-half of the area of Sullivan County and one-sixth of the area of Cheshire County the factors inhibiting the development of true Podzols are relatively weak. In this zone, herein called the "tension zone," only soil series classified as members of the Brown Podzolic great soil group are mapped; but in many places good examples of true Podzol soils developed from the various soil materials occurring in the region may be seen. For example, the Berkshire soils, which are true Podzols, are included in areas of soil mapped as Charlton; the Lyman soils in areas of soil mapped as Hollis; the Hermon soils in areas of soil mapped as Gloucester; the Canaan soils in areas of soil mapped as Shapleigh; and the Becket soils in areas of soil mapped as Essex.

The location of the tension zone, where soil profiles representing both great soil groups occur, together with the location of the zones of Podzols and Brown Podzolic soils, is shown in figure 3.

The extreme result of Podzolic soil-developing processes in this region is illustrated by the Hermon (*3*) and Danby soils. The profile of Hermon sandy loam (included with Hermon stony sandy loam on the soil map) described below was studied in a pit 2 miles north of Sunapee near Jobs Creek, 5,200 feet east of longitude 72° 5′ and 800 feet south of latitude 43° 25′. This place lies within the tension

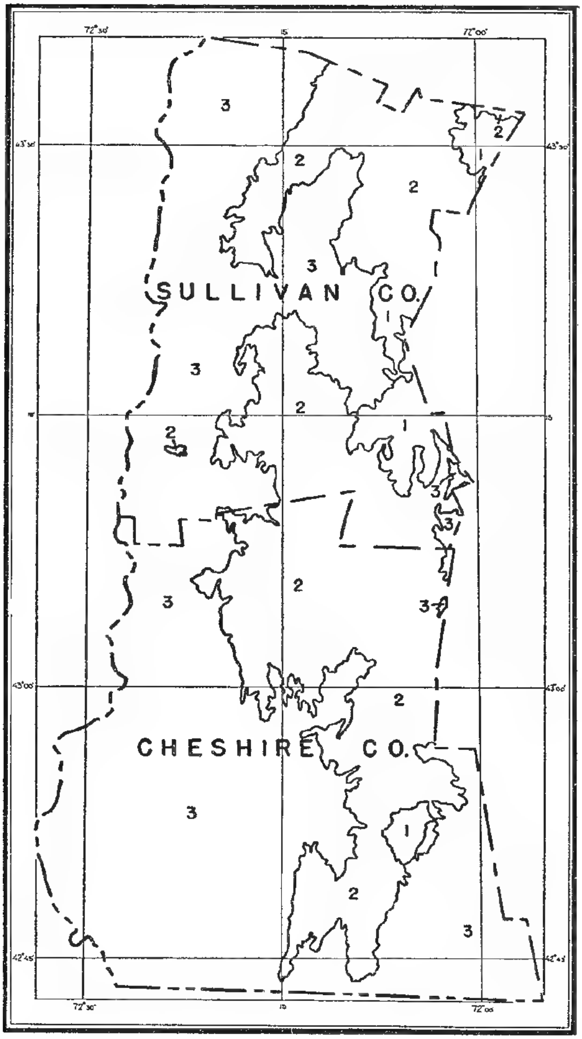

FIGURE 3.—Sketch map of Cheshire and Sullivan Counties, N. H., showing approximate location of the zones of the great soil groups and the tension zone: 1, Podzol zone. In well-drained situations that have not been disturbed, the organic mat is about 4 inches thick and the bleicherde about 2 inches thick. The Hermon soils cover the greater part of this area. 2, Tension zone. Brown Podzolic soils mapped; but, where local environment is suitable, there are small areas of true Podzols, with organic mat about 4 inches thick and bleicherde about 2 inches thick. In most forested places the organic mat is about 2 inches thick and the bleicherde about 1 inch thick. In this zone small areas of Hermon soils occur within areas mapped on Gloucester soils; Canaan in areas of Shapleigh; Becket in areas of Essex; Berkshire in areas of Charlton; Lyman in areas of Hollis; Colton in areas of Merrimac; and Danby in areas of Hinckley. 3, Brown Podzolic soil zone. In forested areas the bleicherde is discontinuous and may be as much as 1 inch thick; but in a few places, particularly where the parent material is outwash or very loose sandy glacial till, the bleicherde is 2 inches thick in spots.

zone and illustrates the fact that good examples of true Podzols can be seen in this region.

A_0. —2 to 0 inch, black or nearly black partly decomposed leaves and twigs.
A_1. 0 to ⅛ inch, black organic matter speckled with gray sand.
A_2. ⅛ to 2 inches, gray loamy sand (bleicherde). The upper part of the horizon is streaked with dark-gray organic matter, but the lower part is nearly white. The pH value is about 4.0.[10]
B_1. 2 to 6 inches, yellowish-brown firm sandy loam without well-defined structure (orterde). The upper part in some places is very dark brown and has soft concretions that indicate the beginning of an ortstein. The pH value is 5.0.
B_2. 6 to 18 inches, brownish-yellow to yellow firm loamy sand without well-defined structure. The pH value is 5.0.
B_3. 18 to 30 inches, grayish-yellow massive firm loamy sand containing some spots of partly weathered gray till. The pH value is 6.0.
C. 30 to 40 inches +, gray gritty till that is slightly compact in place but crushes easily into incoherent sand. It contains small stone fragments and boulders. In general the material is massive, but in some places there is faint evidence of a lenslike platy structure. The pH value is 6.0.

The thickness of each horizon varies greatly within a yard or less of horizontal distance, and in many places fragments of the A horizon lie within the B horizon. According to Lutz and Griswold (*9*), this phenomenon is due to the stirring effect brought about when trees are uprooted by the wind.

Several other important soil series have this same general profile but differ principally in the character of the substratum. The Berkshire soils are not mapped in this area, but they develop on fine-textured comparatively compact till derived principally from schist similar to that on which the Charlton soils develop. The Lyman soils, likewise not mapped in this area, develop on shallow deposits of till similar to those on which the Hollis soils have developed. The Becket soils, which also are not mapped in this area, develop on compact till derived largely from granitic rocks similar to that on which the Essex soils develop. The Danby soils have developed on loose gravelly outwash deposited in kames or very gravelly moraines. The Colton soils developed on loose gravelly outwash deposited as nearly flat terraces.

The average expression of the podzolic soil-forming process in Cheshire and Sullivan Counties results in the development of Brown Podzolic soils. These have a 1- to 3-inch mat of very dark-brown partly decomposed organic matter on the surface. The mineral surface soil, to a depth of ½ to 1½ inches, is light-gray or nearly white loamy sand or fine sandy loam, depending on the texture of the parent material. This is the bleicherde. The orterde, or upper part of the subsoil, to a depth of about 5 inches, is dark-brown or coffee-colored sandy loam or loam. The lower subsoil layer, extending to the parent material, grades through yellowish brown to brownish yellow or grayish yellow. In many places the thin bleicherde is replaced by a dark-gray surface layer, or A_1 horizon, of about equal thickness.

The Gloucester soils (*3*) are mapped where this profile is developed on moderately loose glacial till derived from granite and gneiss. They are the Brown Podzolic counterparts of the Hermon soils. The Shapleigh soil series represents the Brown Podzolic counterpart of

[10] pH determined colorimetrically with brome thymol blue, brome cresol purple, and brome cresol green.

the Canaan soils. The Essex soils are developed on compact platy glacial till derived from granitic rocks. They are the Brown Podzolic counterparts of the Becket soils. The Charlton soils, developed on friable to moderately compact glacial till derived largely from schist rocks, are the Brown Podzolic counterparts of the Berkshire soils. The Hollis soils, formed on shallow deposits of glacial till derived largely from schist rocks, are the Brown Podzolic counterparts of the Lyman soils. The Merrimac soils, developed on nearly level gravelly outwash deposits, are the Brown Podzolic counterparts of Colton soils. Finally, the Hinckley soils, developed on gravelly kames, are the Brown Podzolic counterparts of the Danby soils.

Several soil series are mapped in these counties for which no true Podzol counterparts are recognized. The Woodbridge soils are formed on very compact platy glacial till derived almost entirely from schist rocks. The Marlow soils are developed on compact, platy, glacial till derived largely from gneiss and granite, together with a variable content of reddish-brown micaceous schist rock included in the till or drift.

The Brookfield soils owe their origin to comparatively loose glacial till derived largely from dark micaceous schist or thinly banded gneiss, in many places containing pyrites.

The Jaffrey soils are developed on gravelly kames, and a large content of reddish-brown micaceous schist gravel is present in the parent soil material. (In some areas mapped previously, soils similar to the Jaffrey have been designated as a brown phase of the Hinckley soils.)

The Agawam soils are developed in nearly level situations on moderately fine-grained outwash or river-terrace material derived from schist rocks. The Hartland soils, occupying gently rolling situations, are formed from moderately fine-grained outwash or river-terrace material derived from schist rocks. The Melrose soils are developed in nearly level situations where a thin deposit of gravel is superimposed on fine-grained outwash material. Formed on sandy outwash deposits, the Adams soils resemble the Merrimac soils but have no gravel in any horizon. In many places silt or clay occurs at about a 6-foot depth. Wind-blown sands give rise to the Windsor soils. These soils show very little evidence of soil development.

In some places fine-grained soil material or imperfect drainage conditions allow water to percolate very slowly through the soil, thus hindering or preventing the development of a true Podzol profile. Developed at high altitudes from very fine-grained till derived principally from bluish-gray slaty schist, the Blandford soils have dark-gray or weak-brown surface soils, grayish-yellow or olive subsoils, and compact mottled grayish-yellow, olive, and rust-brown substrata. The Suffield soils are developed on lacustrine deposits of silt and clay. They have weak-brown surface soils, grayish-yellow subsoils, and thinly stratified olive-gray substrata. The Peru soils are developed in imperfectly drained situations at high and average altitudes on all classes of till common to this region. They have grayish-brown surface soils, grayish-yellow subsoils mottled with gray and brown, and mottled substrata, similar in petrographic composition to the associated soils. The Sutton soils are developed in imperfectly drained situations at low altitudes on fine-grained till similar to that underlying the Charlton soils and associated soils.

TABLE 9.—*Key to soil series in Cheshire and Sullivan Counties,*

Origin and character of parent material	Type of soil p			
	Zonal		Intrazonal	
	Podzol	Brown Podzolic		
	Well drained	Well drained	Imperfectly drained	Poor drain
I. Soils of rolling and hilly uplands:				
A. Moderately compact till, principally from schist:				
(1) Gray schist:				
(a) Deep		Charlton	Sutton	Whitma
(b) Shallow		Hollis		
(2) Reddish-brown schist		Brookfield	Peru	Whitma
(3) Developed on broad divides at high elevations		Blandford		
B. Compact till:				
(1) Derived from schist		Woodbridge	Sutton	Whitma
(2) Derived from gneiss and schist		Marlow	Peru	Whitma
(3) Derived from gneiss and granite		Essex	Peru	Whitma
C. Firm, coarse-textured till, principally from granite and gneiss:				
(1) Deep	Hermon	Gloucester	Peru	Whitma
(2) Shallow	Canaan	Shapleigh		
II. Soils on kames and wind-blown deposits:				
A. Kames:				
(1) Derived from granite and gneiss	Danby	Hinckley		
(2) Derived partly from reddish-brown schist		Jaffrey		
B. Wind-blown deposits		Windsor		
III. Soils of nearly level terraces and outwash plains:				
A. Lake-laid materials:				
(1) Clay and silt		Suffield		
(2) Silt and very fine sand		Hartland		
(3) Sand and gravel over silt and clay		Melrose	Sudbury	
B. Medium-textured (stream-terrace) materials		Agawam		
C. Coarse-textured (outwash) materials:				
(1) Sand		Adams	Sudbury	
(2) Sand and gravel	Colton	Merrimac	Sudbury	
IV. Soils of the bottom lands:				
A. Derived principally from schist				
B. Derived principally from granite				

They have dusky-brown surface soils, brownish-yellow upper subsoil layers, mottled gray, brown, and brownish-yellow lower subsoil layers, and fine-grained till substrata. Developed in imperfectly drained situations on terraces, the Sudbury soils have dark-gray surface soils, gray upper subsoil layers, yellowish-brown or mottled yellowish-brown, rust-brown, and gray lower subsoil layers, and gravelly, sandy, or silty substrata. The Whitman soils are developed in poorly drained situations in association with all the soils of the uplands. They belong to the great group of Half Bog soils. They have very dark-gray surface soils and gray or mottled gray, grayish-yellow, and brown subsoils and substrata.

The interrelation of the soils developed on glacial till and outwash material is shown in table 9.

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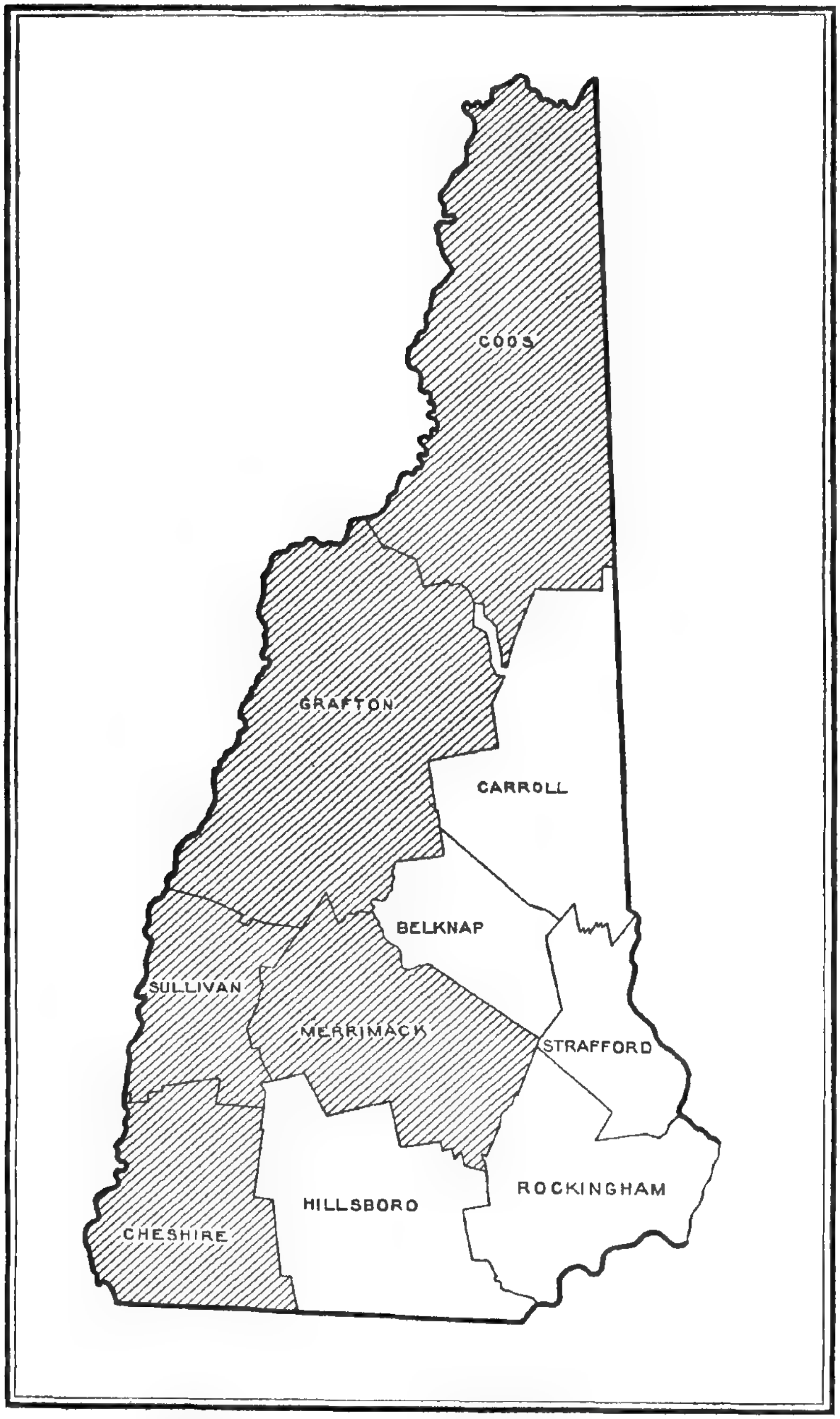

Areas surveyed in New Hampshire shown by shading.

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SOIL MAP
CHESHIRE COUNTY
NEW HAMPSHIRE

UNIVERSITY OF NEW HAMPSHIRE
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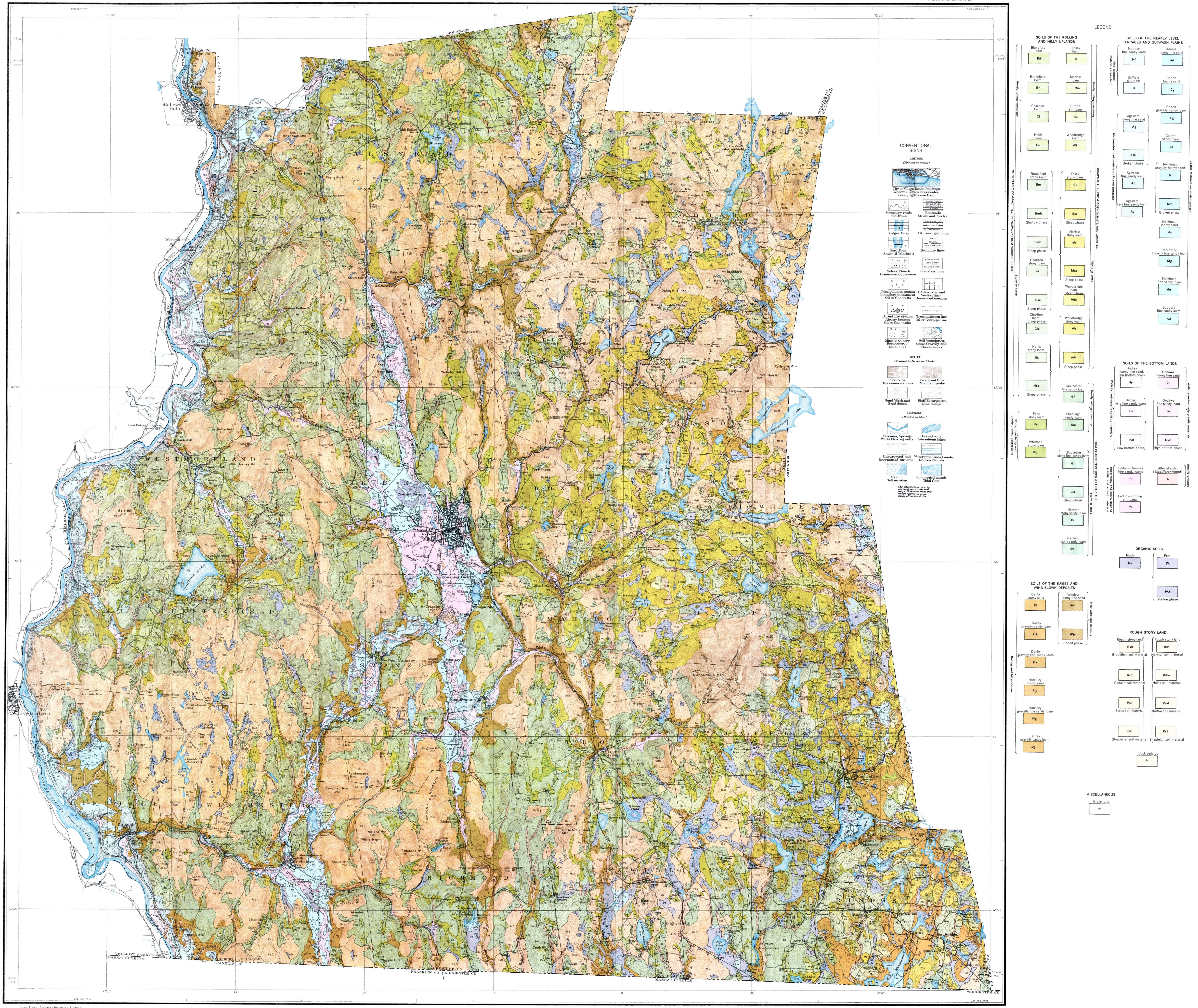

James Thorp, Assistant Inspector, District 1.
Soils surveyed by C. S. Simmons, U. S. Department of Agriculture, in charge, W. H. Lyford, University of New Hampshire.

Scale 1/62500
Contour interval 20 feet

Polyconic projection, North American datum.
Base map in part from U. S. Geological Survey Sheets.
10000 foot grid based upon New Hampshire system of plane coordinates.
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SOIL MAP
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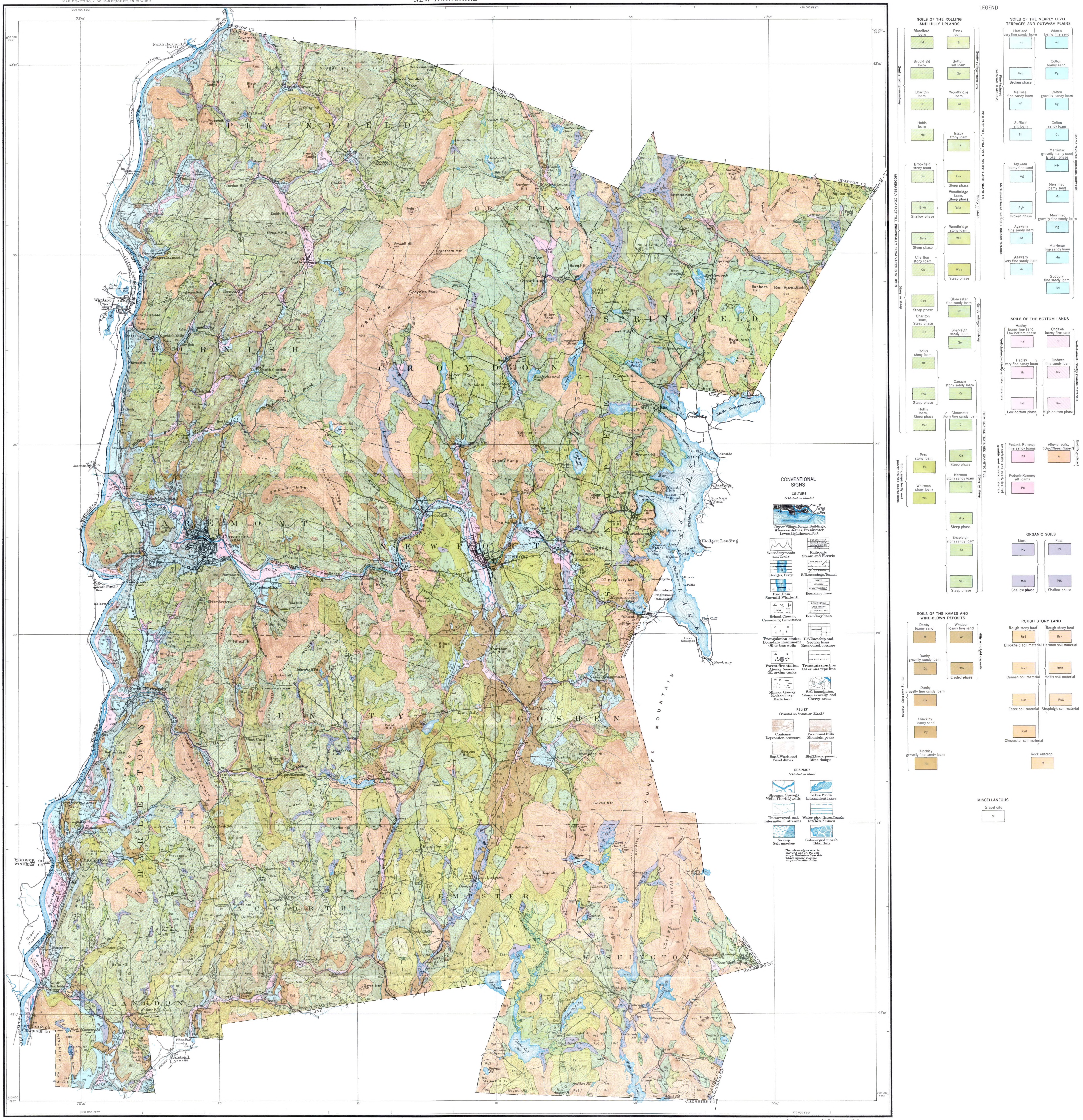

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